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The Biomedical and Behavioral Basis of Clinical Nutrition

A Projection for the 1980s

Report of
A National Conference

Sponsored by the
Nutrition Coordinating Committee,
National Institutes of Health

June 19-20, 1978

NIH
Nutrition
Coordinating
Committee

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
National Institutes of Health

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Artemis P. Simopoulos, M.D., Editor

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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NIH Publication No. 80-1970
November 1979

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Stock No. 017-040-00460-5

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ACKNOWLEDGMENTS

On behalf of the National Institutes of Health and the Nutrition Coordinating Committee, I would like to express my gratitude to the members of the conference organizing group, the participants, and the attendees. I would also like to thank the staffs of the Nutrition Coordinating Committee Office, the News Branch in the NIH Office of Communications, and the Fogarty International Center for their diligence, creativity, and support in preparing for and managing the conference. Ms. Earlene Tarwater in the NCC Office deserves special recognition for her assistance in preparing these proceedings.

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PREFACE

The NIH Nutrition Coordinating Committee hopes that the proceedings of the conference, "The Biomedical and Behavioral Basis of Clinical Nutrition: A Projection for the 1980s," will be read by persons who are engaged in nutrition research and in the teaching and practice of clinical nutrition. The audience, the Committee wishes to reach, includes basic research scientists, clinical investigators, health professionals, allied health professionals, and interested consumers, as well as the many other persons engaged in work in nutrition that is related to preservation of health, such as educators and policy makers.

Research in the area of clinical nutrition is concerned with the relationship between the nutritional experience of a human being and the impact of that experience on his or her life history. Clinical nutrition research is thus concerned with nutritional factors affecting bodily function in both health and disease. In health, it covers the effects of nutritional status on human reproductive performance, physical growth and mental development, and functional aspects of growth throughout the life cycle. In relation to disease processes, the objectives of clinical nutrition research are to identify nutritional conditions that minimize the incidence and prevalence of disease in man, that support tissue function during active disease processes, and that restore normal bodily function following resolution of the pathological processes. Implicit in this is the need to determine the effects of various diseases on requirements for nutrients, the interactions between nutrients and other forms of therapy, and the exploration of methods for delivering adequate supplies of nutrients to patients.

The cultural influences on food selection, and the role of culture in the development of dietary habits or patterns, are specific contributions of behavioral sciences to clinical nutrition as it is the reverse; e.g., the effects of nutrients on the level of neurotransmitters that influence behavior and mood. The particular interaction of genetics and nutrition is a major advance in clinical nutrition that has occurred in the past 25 years.

Advances in nutritional sciences are derived from and thus dependent upon many disciplines (such as biochemistry, molecular biology, genetics, and physiology) and medical specialties (such as internal medicine, pediatrics, and surgery). Thus nutritional science is interdisciplinary and complex, and is heavily dependent upon the close interaction among research, health services, and education to achieve its full potential.

There is growing public desire for more information on the role of dietary practices in disease prevention. The NIH, which has from its inception performed and supported research on the relationship of diet to health and disease, will continue to have a major commitment for uncovering new nutritional information, and for imparting this information to physicians, other health professionals, and the public.

It was therefore considered appropriate that a national conference be held at the NIH to establish the "coming of age" of clinical nutrition--by reviewing the research that formed the scientific basis of clinical nutrition within the past 2 decades, and by establishing directions for the 1980s.

The NIH is the major agency within the Federal Government that supports research and research training in the biomedical and behavioral aspects of nutrition, including studies on nutrition and disease prevention, genetics, behavior, obesity, and total parenteral nutrition; studies on the determination of nutritional status; and special studies on nutrition and epidemiology. The program is not limited to studies carried out in the United States; a special area in international nutrition is an important section of the program.

Research in nutrition at the NIH is supported by:

Division of Research Resources (DRR)
National Cancer Institute (NCI
National Eye Institute (NEI)
National Heart, Lung, and Blood Institute (NHLBI)
National Institute on Aging (NIA)
National Institute of Allergy and Infectious Diseases (NIAID)
National Institute of Arthritis, Metabolism, and Digestive Diseases (NIAMDD)
National Institute of Child Health and Human Development (NICHD)
National Institute of Dental Research (NIDR)
National Institute of Environmental Health Sciences (NIEHS)
National Institute of General Medical Sciences (NIGMS)
National Institute of Neurological and Communicative Disorders and Stroke (NINCDS)

The coordination of the nutrition program is carried out by the Nutrition Coordinating Committee, which operates out of the Office of the Director, NIH.

In developing the plans for the conference, the Nutrition Coordinating Committee established an organizing group* composed of the following persons:

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This conference, on clinical nutrition, was the first to bring together the Department of Health, Education, and Welfare (through the participation of NIH, the Food and Drug Administration, and the Office of the Assistant Secretary for Health), the Department of Defense, and the Department of Agriculture, as well as consumers, congressional staff, and the officers of societies that have special interests in clinical nutrition research.

The audience included members of the press (representing such organizations as the New York Times, United Press International, Chemical Engineering News, the Medical Tribune, National Public Radio, and Associated Press), NIH and other Government employees, nutritionists, dietitians, nurses, physicians, biochemists, biologists, epidemiologists, food scientists, psychologists, anthropologists, pharmacologists, therapists, social workers, educators, university students and professors, educators, the concerned public, and representatives of such groups as the American Heart Association, the American Dietetic Association, the Campbell Institute for Food Research, and the Wheat Flour Institute.

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* The organizing group members are currently or at the time of the conference were officers of the following scientific organizations: Executive Committee Assembly of Life Sciences, National Research Council, National Academy of Sciences; American Diabetes Association; Food and Nutrition Board, National Research Council, National Academy of Sciences; American Society of Clinical Nutrition; American Gastroenterology Association; American Institute of Nutrition; National Nutrition Consortium.

The proceedings are presented in the following order: Appearing first is a section on "Nutrition Research in the 1980s: Recommendations and Implementations," followed by the introduction to the conference by Dr. Donald S. Fredrickson, Director, NIH. Next are the conference addresses, the agency presentations, summaries of the six scientific panels, the consumer and congressional panels, and finally the closing panel which summarized the conferees' positions. This document also contains three appendixes. Appendix I is the Program Agenda from the conference. Appendix II is a reproduction of the NIH Request for Applications (RFA), "Core Grants for Clinical Nutrition Research Units (CNRUs)," which was published as a special supplement to the NIH Guide for Grants and Contracts, January 26, 1979. Appendix III is a list of abbreviations used in this document.

The second item, the RFA on Clinical Nutrition Research Units, is a major accomplishment of the NIH Nutrition Coordinating Committee. The concept of CNRUs was developed by the Committee, and the conference served as a catalyst for its establishment. The objectives of a CNRU are as follows:

1. To create or strengthen foci in biomedical research institutions for multidisciplinary research in clinical nutrition in order to develop new knowledge about specific nutrients in health, human development, and the prevention and treatment of disease.

2. To strengthen training environments in order to improve the education of medical students, house staff, practicing physicians, and paramedical personnel in clinical nutrition.

3. To enhance patient care and promote good health by focusing attention on clinical nutrition and generating nutritional information for the public.

The NIH plans to fund 10 to 12 such Units in FY '79 and '80. Thus, based on CNRUs, a strengthened and more sharply focused national program in clinical nutrition will be established.

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June 1979

NUTRITION RESEARCH IN THE 1980s: RECOMMENDATIONS AND IMPLEMENTATIONS

The NIH Nutrition Coordinating Committee conference, "The Biomedical and Behavioral Basis of Clinical Nutrition: A Projection for the 1980s," was held for two purposes: 1) to review the science base in clinical nutrition, and 2) to project directions for the future. Through the conference addresses, agency program presentations, and scientific, congressional, and consumer panels, certain major recommendations were expressed. In the year that has passed since the conference was held, the NIH has taken a number of actions in implementing these recommendations. The recommendations and the actions taken toward their implementation represent the directions of nutrition research for the 1980s.

RECOMMENDATIONS

1. The NIH should establish a new national program in clinical nutrition through the support and development of Clinical Nutrition Research Units.

2. The NIH should continue to support investigator-initiated nutrition research in areas of particular interest and importance, and should expand its research in clinical nutrition.

3. Concerned NIH Institutes should make a concerted effort to expand training in nutrition research.

4. Current NIH programs in nutrition education for the public and for professionals should be expanded, and new programs should be developed.

5. The coordination of nutrition research programs should be strengthened among the Federal agencies.

IMPLEMENTATIONS

The NIH considered the recommendations emanating from the conference to be important in achieving the ultimate goals of nutrition research and has taken an active role in their implementation. The actions taken with regard to each of the recommendations, as well as plans for further expansion of the biomedical and behavioral nutrition research program, are discussed in the following paragraphs.

Recommendation 1: The NIH should establish a new national program in clinical nutrition through the support and development of Clinical Nutrition Research Units.

In response to the first recommendation, the NIH--through its Nutrition Coordinating Committee and with the participation of the National Institute of Arthritis, Metabolism, and Digestive Diseases, the National Cancer Institute, and the National Institute on Aging--developed a Request for Applications on "Core Grants for Clinical Nutrition Research Units (CNRUs)." The solicitation was published as a supplement to the NIH Guide for Grants and Contracts on January 26, 1979 (see Appendix II).

A CNRU is an integrated array of research, educational, and service activities that is oriented toward human nutrition in health and disease. Core grants facilitate the planning and coordination of the activities of the Units primarily by providing funding for facilities and associated staff that serve the various projects of the Unit on a shared basis.

The NIH has traditionally sponsored the component activities of CNRUs through a variety of award mechanisms: the principal ones have been research project grants and support for research training. The present initiative, core grants for shared facilities, is likely to become an invaluable addition, especially in promoting multidisciplinary interactions. This approach also tends to ensure that a given CNRU has multiple sponsors, both Federal and non-Federal, and thereby reduces the likelihood that it will become unduly dependent upon any one source of funds for its continuing operations. Funding for educational programs and nutritional support services (patient care) will generally be sought from sources other than the NIH.

A CNRU, at a minimum, must comprise the following seven components:

1. Research with human subjects and populations;

2. Laboratory investigations;

3. Research training;

4. Shared facilities and research services;

5. Education programs for medical students, house staff, practicing physicians, and paramedical personnel;

6. Nutritional support services; and

7. Public information activities.

A CNRU is most readily developed in a medical school, a school of public health, or a research hospital, but is not limited to these settings.

It is expected that all CNRU Directors will meet annually for a 2-day meeting at the NIH with NIH staff. The purpose of the annual meetings is to facilitate communication, to review research findings and problems, and to discuss administrative concerns and constraints. Thus, a strengthened and more sharply focused national program in clinical nutrition will be established.

The first CNRUs will be funded in September 1979. The NIH plans to establish 10 to 12 CNRUs in FY '79 and '80.

Recommendation 2: The NIH should continue to support investigator-initiated nutrition research in areas of particular interest and importance, and should expand its research in clinical nutrition.

In response to the second recommendation, the NIH, through the various Institutes and the Nutrition Coordinating Committee, has developed a number of Requests for Applications (RFAs) and Program Announcements to enhance its program in clinical nutrition as well as other aspects of nutrition research. Some of these RFAs and Program Announcements have been developed jointly through the Nutrition Coordinating Committee, and others have been developed by individual Institutes at the NIH.

- "Studies on Overnutrition and Obesity" -- NCC: NHLBI, NIA, NIAMDD, NIAID, NICHD, and NINCDS

  The NIH Nutrition Coordinating Committee developed a Program Announcement to solicit grant applications in basic, clinical, and behavioral research aspects of exogenous obesity. The following Institutes are participating in this joint announcement: the National Heart, Lung, and Blood Institute, the National Institute on Aging, the National Institute of Arthritis, Metabolism, and Digestive Diseases, the National Institute of Allergy and Infectious Diseases, the National Institute of Child Health and Human Development, and the National Institute of Neurological and Communicative Disorders and Stroke.

  Obesity is a major public health problem in the United States, affecting both children and adults. It is either a risk factor or is associated with a number of diseases including diabetes, hypertension, coronary heart disease, complications of pregnancy, osteoarthritis, and some cancers and infections.

Despite the magnitude of the problem, the causes of exogenous obesity remain obscure. Overeating is only one aspect of a multifaceted etiology. The socioeconomic and behavioral causes of overeating have not been defined; there is also a lack of definition of the reason for the differential metabolic consequences that lead to obesity in some, but not all, individuals who eat a similar diet.

Examples of areas of research requested in this Program Announcement include the following: the heterogeneity of obesity; physiological and psychological factors that affect eating behavior; obesity as a risk factor, energy balance and change in metabolic rate as a function of age; fat cell control and proliferation; and weight management. A significant number of applications have been submitted and are at various stages of the review process.

- "Infant Nutrition" -- NICHD

The Developmental, Biology and Nutrition Branch of the National Institute of Child Health and Human Development issued an RFA seeking applications directed toward fundamental and clinical aspects of infant nutrition that may improve the nutritional management of the newborn. The RFA encourages studies on the ontogeny of metabolic function of the neonate and the diversity and function of components of human breast milk and colostrum. Specific areas of interest include the following: physiological capacities of the neonate; assessment of nutritional status of the developing neonate; effects of components of human milk and colostrum on the physiological development of the neonate; and various aspects of human milk and colostrum, including nutritional composition, temporal variation, immunological properties, effects of processing and storage, and nutritional efficacy. To date, 23 grants and one program project have been funded.

- "Nutrition in Relation to Health of the Aged and Aging Processes" -- NIA

This Program Announcement from the National Institute on Aging is intended to encourage the increased development of research on clinical and basic nutrition over the full spectrum of interrelationships between nutrition, aging processes, disease prevention, health status, and optimal health maintenance with age. Selected areas for emphasis are the following: basic epidemiological and clinical research; special nutrition-related problems in the aged adult; effects of aging on nutrient utilization, digestion, absorption, and metabolism; and the interrelationships between aging and the factors that regulate the effects of nutritional deficiencies and nutrition and age-related mental deterioration. A total of three grant applications have been funded to date.

o "Nutritional Aspects of Cancer and Its Etiology/ Prevention, Treatment, Rehabilitation, and Training" -- NCI

The Diet, Nutrition, and Cancer Program of the National Cancer Institute issued this Program Announcement to expand its research in the nutritional aspects of cancer.

Within the category of etiology and prevention, applications are sought in such areas as the following: identification of mutagens and carcinogens in human food; evaluation of methods of cooking and processing of foods relative to the formation of mutagens and carcinogens; dietary/nutritional approaches to the inhibition of carcinogenesis; determination of the effects of individual vitamins on the inhibition or promotion of the carcinogenic process; studies on the role of dietary fiber; and studies on the effect of diet and nutrition on tumor induction and incidence.

With regard to treatment, the NCI is aware that end results in cancer management may be enhanced by expanding our understanding of the mechanisms of malnutrition in cancer patients, and attempts at therapeutic intervention designed to interrupt these mechanisms and/or provide nutritional support. Specific areas of interest include: anorexia, host/tumor competition and cachexia metabolism; consequences of nutritional deficiencies and the role of dietary supplementation; complications of antineoplastic therapy; and nutritional deficiencies as antineoplastic therapy.

Rehabilitation in cancer is concerned with prevention of impairment, maintenance of host strength and function, and the early restoration of functional loss as a result of cancer or its treatment. Relevant areas for the submission of applications include: dietary counseling for pediatric patients and their parents; effectiveness of psychological support as an appetite stimulant; and consequences of malnutrition in host impairment and its relationship to patient rehabilitation.

A total of 15 grants have been funded from responses received to this NCI announcement.

o "The Role of Nutrition in the Rehabilitation of Cancer Patients" -- NCI

This RFA was issued by the NCI because advances in modern medicine have increased survival time and longevity for an increasing number of cancer patients, but the aggressive treatment required frequently results in serious residual physiological and psychological consequences to the patient. Rehabilitation must employ newer modalities and explore unique approaches if the morbidity so common to cancer is to be reduced. Since nutrition may be just such a modality, the NCI issued an RFA to encourage grant applications to study the effect of specially designed nutritional manipulation on the cancer rehabilitation process. The research may consider any of the various components of nutrition as it relates to: prevention of impairment secondary to the disease and/or treatment; the earlier restoration of lost physical and psychological function secondary to cancer treatment; regimens for host maintenance during the course of treatment; altering states of disability through nutritional manipulation; and the effect of nutrition on the psychological state of the cancer patient. Since review of responses to this RFA is still in process, funding will not begin until FY '80.

- "Effect of Diet on the Metabolism, Structure, Composition and Blood Levels of High Density and Other Lipoproteins" -- NHLBI

The National Heart, Lung, and Blood Institute issued the above RFA, pointing out that there is an increasing consensus that nutritional research must be pursued in tandem with biochemical, physiological, and epidemiological approaches to the question of what causes coronary heart disease. Despite the fact that the relationship between diet and atherosclerosis was recognized quite early in the study of this disease, significant gaps remain in our understanding of the effect of various nutrients or intake patterns on atherogenesis.

An obvious need exists for more basic information on the effect of diet on high density lipoprotein (HDL) and other lipoproteins, including investigations into long-term dietary influences, dietary control mechanisms for apoprotein synthesis and degradation, and the steady state levels of these lipoprotein families and their constituents under various caloric intakes.

The RFA requests studies in such areas as the following: the effect of dietary perturbations on the composition, metabolism, and function of HDL, their apoproteins, and other lipoproteins or apoproteins; the chemistry of HDL apoproteins in relation to diet; the response of the circulating levels of HDL to various nutrient intake levels; relationship of HDL metabolism and its concentration in the circulation to specific components of the diet such as cholesterol, saturated and unsaturated fatty acids, and plant sterols; the effect of noncaloric dietary components (such as crude fiber and essential vitamins and minerals) on HDL levels and metabolism; the effects on HDL metabolism of complex versus simple carbohydrates; the relationship of weight gain or loss to HDL levels amd metabolism, and the effects of diet on lipoprotein metabolism in animal models. Ten grant applications have been funded in response to this RFA.

- "Research Grant Support in Nutrition" -- NIAMDD, NICHD, NIAID, and NCI

  In addition to RFAs and Program Announcements for research in nutrition in terms of domestic or national needs, several of the Institutes have developed a joint Program Announcement for research grant support through the Malnutrition Panel of the U.S.-Japan Cooperative Medical Science Program. Participating in this joint announcement for basic and clinical research related to nutritional problems of importance to the health of Asian people are the National Institute of Arthritis, Metabolism, and Digestive Diseases, the National Institute of Child Health and Human Development, the National Institute of Allergy and Infectious Diseases, and the National Cancer Institute.

  The Malnutrition Panel has identified the following areas that should receive increased research emphasis: environmental and host factors affecting nutritional requirements; iron deficiency; nutrition and infection; effects of nutrition on physical and mental development, behavior, physical capability, and work performance; and health consequences of different, and changing, dietary patterns and food habits. The announcement also states that studies are needed which focus on motivation, stress, and cultural and social influences as these affect dietary habits, food preferences, and behavior. In addition, research is needed on the cultural and behavioral determinants of individual nutrient intake, hunger, and satiety. Several applications have been received and are currently being reviewed.

In addition to the expansion of support of nutrition research through the issuance of Program Announcements and RFAs, two Institutes have issued Requests for Proposals (RFPs) in the following areas:

"In Vivo Quantification of Body Nitrogen," NCI

"Quantification of Changes in Body Composition in Cancer Patients," NCI

"Development and Validation of Standard Procedures for the Nutritional Assessment and Monitoring of Adult and Pediatric Cancer Patients and Normal Individuals," NCI

"Human Milk Bank Research and Distribution Center," NICHD

Furthermore, the NICHD has developed a new program in Clinical Nutrition and Early Development. The objective of the Program is to extend the Institute's existing science base toward new understandings on the role of nutrition in the prevention of disease and promotion of health. The new Program will support studies on behavioral, social, and cultural influences on diet and nutrition and will be complementary to the Institute's current activities in nutrition research. The Program will emphasize research on the psychosocial, evolutionary, and anthropological components of nutrition. Research areas of priority for the first year of the Program have been identified as: 1) nutritional individuality; 2) nutrition and evolution; and 3) development and modification of dietary patterns. To date, three RFPs have been issued to initiate research effort, as follows:

"Prevalence and Impact of Nutritional Individuality"

"Metabolic Basis of Nutritional Individuality"

"Nutritional Individuality and Dietary Patterns"

The NIA will implement an extensive program in adult clinical nutrition. With this program, the NIA aims to build the first comprehensive body of new knowledge on dietary intake, nutrient utilization, nutritional status, and the influence of these factors on the promotion and maintenance of optimal health in the aged.

In addition to the development and issuance of RFAs, Program Announcements, and RFPs to enhance its nutrition research program, the NIH has held or is planning to hold conferences to stimulate research in specific areas in nutrition, and thus further expand its program. Examples are the following:

"Nutrition and Health of the Aged Adult," sponsored by the National Institute on Aging, June 5-7, 1978, Bethesda, Maryland

"Nutrition, Behavior, and the Life Cycle," sponsored by the National Institute on Aging and the National Institute of Child Health and Human Development, June 18-20, 1979, Bethesda, Maryland

"Methodologies for Human Population Studies in Nutrition Related to Health," sponsored by the U.S.-Japan Malnutrition Panel, U.S.-Japan Cooperative Medical Science Program, July 24-25, 1979, Bethesda, Maryland

"Nutritional Support of the Patient: Research Directions for the 1980s," sponsored by the NIH Nutrition Coordinating Committee, September 17-18, 1979, Chantilly, Virginia

"Nutrition Education in the 1980s," sponsored by the DHEW Nutrition Coordinating Committee with support from the NIH and other agencies of the Public Health Service, September 27-28, 1979, Bethesda, Maryland

Recommendation 3: Concerned NIH Institutes should make a concerted effort to expand training in nutrition research.

Increasing the numbers of research personnel is an essential aspect of the NIH Biomedical and Behavioral Program in Nutrition Research. Thus, in response to the third recommendation, the NIH is expanding its program in nutrition through the mechanisms of training grants and fellowships. The Nutrition Coordinating Committee has recently developed two Program Announcements within the National Research Service Award program: one is designed to provide postdoctoral research training to *individuals* to broaden their scientific background and extend their potential for research in nutrition, and the other is designed to enable *institutions* to make training grants to individuals selected by them for predoctoral and postdoctoral research training in nutrition. The following Institutes are participating: the National Cancer Institute, the National Eye Institute, the National Heart, Lung, and Blood Institute, the National Institute on Aging, the National Institute of Arthritis, Metabolism, and Digestive Diseases, the National Institute of Dental Research, the National Institute of Environmental Health Sciences, and the National Institute of Neurological and Communicative Disorders and Stroke.

Recommendation 4: Current NIH programs in nutrition education for the public and for professionals should be expanded, and new programs should be developed.

The NIH has implemented the fourth recommendation in several areas, as described below.

a. Subcommittee on Nutrition Education

The NIH Nutrition Coordinating Committee established a permanent Subcommittee on Nutrition Education in October 1978. The subcommittee includes dietitians, physicians, communications experts, and educators and is thus multidisciplinary. In addition, when necessary, the membership is supplemented by *ad hoc* members who possess special expertise needed for the publication under review. The charge of the subcommitte is: 1) to review NIH *nutrition documents* designed for the public prior to their publication; 2) to develop *public service announcements* (PSAs) for radio and TV; 3) to develop *films* on nutrition; and 4) to develop an NIH *Newsletter* on Biomedical and Behavioral Research and Research Training.

The Institutes have cooperated fully with the subcommittee in submitting nutrition documents for review. For example, in recent months the subcommittee members have reviewed the following draft publications, prepared by the National Institute of Child Health and Human Development: "Nutrition in Pregnancy," "Nutrition in Infancy," and "A Parent's Guide to Cystinosis."

In addition to reviewing documents, the subcommittee also cooperates with the Institutes in the actual preparation of nutrition materials. For example, the NCC Office is currently working jointly with the National Institute of Arthritis, Metabolism, and Digestive Diseases in updating the pamphlet entitled "Facts About Obesity."

The subcommittee has worked with representatives from the NIH Office of Communications in the preparation of a public service announcement on "Sensible Weight Loss," and production is now complete.

b. Nutrition Newsletter

The Nutrition Coordinating Committee, through its Subcommittee on Nutrition Education, hopes to begin publication of a Nutrition Newsletter in 1980. This bimonthly publication will be generally intended for nutrition professionals, including NIH grantees, members of the National Nutrition Consortium, Federal agencies, state health departments, medical schools, schools of public health and schools of nutrition, private foundations, committees of Congress and their staff concerned with nutrition, the Office of Technology Assessment, and the concerned public. The following regular features are planned for each issue: 1) a column entitled "A Word from the Director," to be written by the Director, NIH, or by Institute Directors, Program Directors, or the NCC Chairman; 2) progress reports on research, or new findings; 3) a list of Requests for Applications, Requests for Proposals, and program announcements in nutrition; 4) a list of funded nutrition grants, contracts, training grants, fellowships, and Research Career Development Awards (RCDAs); 5) reports on legislative hearings in nutrition; 6) announcements of or reports on nutrition conferences/workshops/symposia held at NIH or sponsored by NIH and held in the United States or abroad; and 6) other items of interest.

c. National Conference on Nutrition Education

In September 1979, the DHEW Nutrition Coordinating Committee will hold a national conference on nutrition education. Over 50 percent of the financial support for the conference is being provided by the NIH, and the conference will be held on the NIH campus in Bethesda.

d. "HEalthWorks '79" -- Nutrition Test

The NIH participated in "HEalthWorks '79," a DHEW-sponsored health fair **that was held** on the Mall from May 22 through May 24, 1979. "Nutrition" was one of several themes included in the fair; others included "Exercise" and "Coping with Stress." The NIH Nutrition Coordinating Committee was responsible for the following items in the nutrition exhibit area:

- Eat Hear - A cafe where sound nutrition could be learned through menu choices served in tape cassette form.
- Eat Right Arcade - Question and answer game about nutrition.
- Walk-Through Fat Cell
- Breakfast-Lunch-Dinner Theater - Nutrition demonstrations on stage.

e. Medicine for the Layman

"Medicine for the Layman" is a series of lectures by NIH physicians on the human body--in health and disease. The series is sponsored by the NIH Clinical Center, and is videotaped for possible use on public television. In the fall of 1978, the series included a lecture on infant feeding, and in November 1979, a lecture on "Nutrition: Infancy Through Adolescence" will be presented.

f. Nutrition Education for Professionals

Nutrition education for the public will never be complete unless physicians, paraprofessionals, nurses, etc. themselves receive adequate training in nutrition. To this end, the NIH has continued to sponsor workshops and conferences for professionals. For example, the National Cancer Institute held a workshop on "Physician Education in Cancer Nutrition" on June 4-5, 1979, and a state-of-the-art workshop on fat and cancer is being planned for the fall of 1979. In addition, the National Heart, Lung, and Blood Institute has initiated sponsorship of one-day regional workshops, which are designed for local practicing physicians and nutrition counselors.

Recommendation 5: The coordination of nutrition research programs should be strengthened among the Federal agencies.

Another major direction for the 1980s is the coordination of nutrition research programs among the Federal agencies.

The Office of Science and Technology Policy in the Executive Office of the President has established a Joint Subcommittee on Human Nutrition Research composed of representatives from the Department of Health, Education, and Welfare, the Department of Agriculture, the Department of Commerce, the National Science Foundation, the Department of Defense, the Department of State, the Federal Trade Commission, and the Veterans Administration. The Subcommittee is cochaired by Dr. Mark Hegsted of the Department of Agriculture and Dr. Artemis P. Simopoulos of DHEW/NIH. The office of the NIH Nutrition Coordinating Committee is responsible for the Executive Secretariat functions of the Subcommittee.

The purpose of the Subcommittee on Human Nutrition Research is to increase the overall effectiveness and productivity of research efforts in nutrition. In fulfilling this purpose, the Subcommittee will: 1) improve planning, coordination, and communication among Federal agencies engaged in research and training in nutrition; 2) develop and update plans for Federal research programs to meet current and future domestic and international needs for nutrition; 3) collect, compile, and disseminate information on nutrition research; and 4) prepare reports describing activities, findings, and recommendations of the Subcommittee.

. . . .

In view of the progress made over the last year in implementing the recommendations of the conference, the NIH anticipates that we can all look ahead to major advances in nutrition research in the 1980s.

GREETINGS AND INTRODUCTION

Donald S. Fredrickson, M.D.
Director
National Institutes of Health

I am emboldened by the sight of all the good friends and extraordinary talent that have come to address this most important topic with us here at the National Institutes of Health. I want to extend a very warm welcome to all of you, and I certainly want to thank at the outset, as we must at the end, the program participants for their contributions and for the time they have taken to organize this meeting with us.

This is one of the first times, I think, that so ecumenical an audience--Government, science, people from many walks of life and many interests in the subject--have come together to develop a program of analysis of the research into the biochemical and behavioral basis of clinical nutrition.

We are particularly pleased, I think, that one of our fellow agencies, the Food and Drug Administration, and two other Departments within the Government, the Department of Agriculture and the Department of Defense, which have great interests in clinical nutrition research, will also be participating in this conference by presenting their programs in clinical nutrition along with that of the NIH.

It is often unnecessary, I suppose, and yet almost irresistable, to retrace some of the roots of research here at the NIH. We believe that we are 90 years old, although not under the name of the National Institutes of Health. But the old Hygienic Laboratory is that old, and it was our direct predecessor. One of the patron saints in that organization, which was devoted primarily to research in infectious disease and nutrition, was Joseph Goldberger, the discoverer of pellagra as a nutrition deficiency disease.

Dr. Sebrell, former Director of NIH, is here today. In 1947 his laboratories of Nutrition, Chemistry, and Pathology, then located in Bethesda, were incorporated under the Experimental Biology and Medicine Institute, which in 1950 changed its name to become the National Institute of Arthritis and Metabolic Diseases. The evolution of that Institute's interest and range and its name have continued since that time.

Certainly the current nature of intramural nutrition research in the Public Health Service is quite different from that initiated by Dr. Goldberger and by Dr. Sebrell and their many colleagues. Yet the Laboratory of Nutrition and Endocrinology remains today as a research facility within the National Institute of Arthritis, Metabolism, and Digestive Diseases.

All of you know that, in the early 1960s, what is called "classical nutrition" began to be de-emphasized not only here but around the world, reflecting a trend toward pursuit of nutritional questions in more reductionist terms in fields of biochemistry, physiology, and more basically oriented disciplines. That trend continues to the present. One of the reasons we are here today is to examine the question of whether that reductionist trend, enormously successful, needs to begin to swerve back toward a more holistic approach to the subject of nutrition, so that we might take maximum benefit from all that has been learned and convert it into recipes for longer life and greater well-being of both healthy persons as well as patients who are ill.

Although the amounts that are involved have been the subject of a tug of war recently, and it is no wonder because the semantics are formidable, no matter what accounting method is used, the National Institutes of Health is probably the biggest single supporter of nutrition and clinical nutrition research in the United States, perhaps in the world. It is an area of research in which this agency is especially well qualified to play a leading role, because of the amalgam of biology and medicine that is represented.

Over $90 million can be attributable to nutrition research in our budget today, and that program ranges extraordinarily widely and throughout all the Institutes. Today we see, in this year, the beginning of two new nutrition programs at both ends of life, one in the National Institute of Child Health and Human Development and one in the National Institute on Aging, developing to move together to create a bridge for the conversion of information and knowledge about nutrition into a support of behavior and improvement in the well-being of human beings from every age and all walks of life.

A tremendous amount has been achieved, and today one of the purposes is to look at that. What is missing? Where are the gaps? And where must we go from here?

CONFERENCE ADDRESSES

CONFERENCE ADDRESS

"THE INTELLECTUAL BASIS OF RESEARCH IN CLINICAL NUTRITION"

Rene Dubos, Ph.D.
Professor Emeritus
Rockefeller University

Many people of the Western world, especially in the United States, are intensely worried about the quality of their food and about their nutritional state, but this is chiefly because they constantly read and hear that they have reasons to worry, not necessarily because they are malnourished. Any departure from what is assumed to be the ideal dietary regimen becomes public event chronicled by the mass media--thus contributing to the prevalent social neurosis about the general state of the world.

In reality, the immense majority of people in the countries of Western civilization now have a diet that is far better balanced and freer of toxic effects than was the case at almost any time in the past--except perhaps far back in the Stone Age. This does not mean that our food and nutritional state are ideal. Their shortcomings, however, do not stem from a deterioration of our dietary regimen, but from its lack of adaptation to our present ways of life. We know a great deal about the production and characteristics of the various kinds of food, but very little about what should be the diet of a particular person in a particular physiological, occupational, or behavioral situation.

In 1946, Oxford University was offered large funds to create a new Institute of Human Nutrition. The University refused the funds on the grounds that the knowledge of human nutrition was essentially complete and that the proposed Institute would soon run out of meaningful research projects. Indeed, most of the essential growth requirements were then known, and there was an illusion that a consensus would soon be achieved concerning recommended daily allowances for each dietary item. It was also felt that prevalent methods of food control were sufficient to eliminate most serious dietary accidents due to toxic or other physiological disturbances. The Oxford authorities did not differentiate food production and control from the far more complex physiological problems relating food intake to nutritional state.

The fact is, however, that knowledge is profoundly deficient in all aspects of the nutrition problem. Persons differ widely in their requirements depending upon cultural habits, ways of life, individual genetic differences, and last, but perhaps not least, behavioral patterns. Pathological manifestations have occurred that were completely unanticipated a generation ago and which are still poorly understood today. Furthermore, and probably most important, human beings are capable of biological and social adaptations to a great diversity of nutritional conditions--adaptations that make a mockery of attempts to define precisely an optimum diet for the hypothetical average person.

The Nutritional Adaptability of Humankind

Many people believe that they can function well only when provided with three square meals a day, and certain students of nutrition believe that this formula constitutes the surest way to a good nutritional state. But in fact, few are the societies in which the practice of three square meals a day is considered desirable for health.

In the economically humble French environment from which I emerged, for example, the substantial meal was at noon. Supper was a desultory affair. As to breakfast, it consisted of bread, with a cup of cocoa for children and coffee for adults. Never did a glass of orange juice or tomato juice reach my lips until I had settled in the United States. Yet here I am to tell the tale at the age of 78. My sister and brother, who are both in their mid-70s and living in Paris, are also doing well on the same regimen, as are my French nieces and nephews. There are tribes in which people nibble constantly and others which partake of only one meal a day. At Harvard University I knew a famous medical scientist who ate only at dinner time when he could make the meal a rather elaborate social occasion.

In East Africa, the Kikuyu people are healthy and can develop a good physique on a purely vegetarian diet. In contrast, the Masai people who live in the same region derive practically all their nourishment from milk and from the blood of their cattle that they bleed daily--yet they do as well as the Kikuyu without much intake of the plant fiber that is so much on our minds today.

I could go on and on with examples illustrating that social groups and individual persons have successfully adapted themselves to very different dietary regimens. I find it more useful, however, to discuss at some length a more drastic phenomenon of nutritional adaptation, namely adaptation to extremely low food intake throughout the life span.

During the 1940s, I participated in the research activities of the Institute of Nutrition for Central America and Panama (INCAP), located in

Guatemala City. The average food intake per capita in the villages of Guatemala was then, and still is, extremely low and deficient in protein. Many children and young adults died of infection. But the adults who survived, although of very short stature and seemingly frail, were capable of physical efforts far greater than those expected of vigorous Europeans and North Americans--such as carrying heavy burdens on their backs over long distances up and down mountains. Physiologic studies showed that they could maintain themselves in caloric and nitrogen balance on a diet that would have meant starvation for most Europeans and especially for North Americans. Furthermore, these skinny people, grossly undernourished according to our standards, commonly lived to a good old age.

Since Guatemalans raised in wealthier surroundings and fed a rich and abundant diet became as large physically as people of Europe and North America and exhibited the high nutritional requirements of these countries, it can be assumed that the anatomical and physiological characteristics of the adult village Guatemalans were not the consequence of genetic peculiarities, but rather of adaptation to low food intake.

Before World War II, most adult Japanese men and women were of small size, and this is still true of Japanese persons over 40 years of age. In contrast, the average size of Japanese teenagers and young adults is now close to that of young Caucasians in the prosperous parts of the world. The phenomenal increase of body size in Japan cannot be due to genetic factors since it occurred within one generation. One of its reasons may be the control of childhood diseases, and another is probably the profound changes in the Japanese diet since the end of the war. Between 1950 and 1975, for example, the per capita average consumption increased 15 fold (not 15 percent) in the case of milk, 7.5 fold in the case of meat and eggs, and 6 fold in the case of fat--whereas the per capita consumption of rice and potatoes decreased significantly. The changes in stature and physiological characteristics of the Japanese population during the period are illustrated in the following table, which presents average values for girls 12 years old:

Physique of Girls 12 Years Old

	Japanese				U.S. white
	1950	1960	1970	1974	1974
Height (cm)	136.8	143	148	148.5	149.1
Weight (kg)	32.0	36.5	40.3	41.0	40.9
Age of menarche (yr)	15	14	12.5	12.2	12.5

Thus it seems certain that the pre-war Japanese people had adapted biologically to a low intake of certain nutritional elements (probably protein and fat) by remaining small during youth and throughout life. This biological adaptive state had such profound effects that adult and old Japanese people grown under such conditions do not significantly increase in size even when they adopt the much richer and abundant diet of present days.

At the beginning of the present century, American nutritionists had worked out Recommended Daily Allowances for the various essential nutrients, in particular proteins; these values had been established from studies carried out on vigorous young adults, chiefly college students. Almost unanimously, however, nutritionists of other countries considered the American RDAs far too high.

After heated discussions, the commissions on nutrition of the WHO and FAO decided in the early 1970s to scale down the protein requirements of a healthy person by some 30 percent--eliminating thereby, by administrative decision, much of the international "protein gap" that had been postulated in earlier decades!

Recent American studies have been interpreted as meaning that the redefined protein standards may be too low because a group of U.S. university students fed the new "safe" level of protein developed signs of protein deficiency after 2 months. The explanation of this finding, however, is probably in the fact that, at all social levels, American children were (and to a large extent still are) fed diets much richer and abundant than European children--let alone children of developing countries. To a large extent, the nutritional requirements of adults thus seem to be determined by early nutritional conditioning. One of the most important problems of nutrition science is thus to study the effects of early conditioning on nutritional requirements.

It has long been recognized of course that nutritional requirements change with age and are different for men and women. But the values calculated in the past may have lost much of their validity now that ways of life have changed so profoundly. For example, the amount of physical activity and of exposure to cold are certainly factors of importance in this regard. Furthermore, it is certain that genetic constitution profoundly influences nutritional requirements. Each one of us has a nutritional-metabolic pattern as characteristic, indeed as unique, as our fingerprints. For this reason, according to Professor Williams, the minimum requirements of a person of a given age, for any particular item, may differ by a factor of 3 to 10, simply because of genetic differences.

Pathological Effects Associated with Dietary Regimens

It might be argued that the easiest way out of these complexities is to provide for each person the maximum practical amount of food. But this is not advisable because there is convincing evidence that any foodstuff in excess of the proper amount can become the cause of pathological damage. Classical examples are the claims of association between salt intake and hypertension and of the correlation between coronary heart disease and the blood levels of cholesterol and saturated fatty acids.

At a conference on "Cancer and Diet" held in Seattle in March 1977, it was claimed that the change to Western type of nutritional patterns in Japan, mentioned above, has been accompanied by marked increases in the mortality of certain forms of cancer among women 50-54 years of age, as shown in the following table:

Cancer Mortality in Females 50-54

	Japanese				U.S. white
	1950	1960	1970	1974	1974
Breast	4	3.7	6.0	7.1	19
Colon	2.7	6.3	7.0	8.1	26
Stomach	72	61.0	54.0	42.0	4.1
Uterus	79	41.0	25.0	21.0	14.0

The increases in mortality from cancer of the breast and of the colon seem the more convincing because they are accompanied by a decrease in cancer of the stomach and of the uterus, thus approaching the patterns common in the United States, and suggesting that Western nutritional habits were really responsible for these dramatic changes.

Correlations derived from epidemiological studies do not, of course, constitute evidence of cause-effect relationships. A case in point is the current debate over cancers of the bowel (the colon and the rectum). These cancers are common in developed Western nations, but rare in the developing countries. Such difference is certainly due to environmental rather than genetic factors since Japanese who have settled in the United States succumb to bowel cancer at the high U.S. rates, rather than at the much lower rates prevailing in Japan.

But whereas the facts concerning incidence seem well established, the explanations are highly questionable. Two theories are popular at the present time: one centered on the decrease in dietary fiber intake, and the other on the increase in dietary fat wherever people adopt the ways of Western civilization. Either or both of these theories may have some validity, but neither of them has been indisputably established. Any change in dietary regimen involves a multiplicity of other changes in the ways of life and also in chemical intakes, since any item of food contains many substances other than those determined by the analytical processes used to evaluate their nutritive values.

So-called natural foods are no more innocent of potential danger than are processed foods. Suffice it to mention as examples, among countless others, that potatoes contain a substance, solanin, which would reach toxic levels if ten times the usual amount of potato were consumed at one sitting. Whole wheat, oatmeal, and other cereal grains contain phytic acid, which interferes with the absorption of calcium and iron in unleavened products. Excessive consumption of certain foods can produce goiter. Colza oil (rape seed oil), which is an important item of human nutrition in large parts of Europe, has been shown to produce irreversible lesions of the myocardium in several animal species, even when administered in fairly low doses. And there are many constituents of natural foods that can produce cancers in one animal species or another.

The recognition that potentially dangerous substances are present in practically all "natural" foods puts the problem of food additives in a peculiar light. One can predict that, if the standards used to test man-made chemicals were applied to "natural" foods, fully half the human food supply would have to be banned. The Delaney Amendment, which forbids the addition to food of any material shown to produce cancer in animals in any dose, would certainly lead to decisions unacceptable to the public if it were applied to the letter of the law.

The new analytical techniques permit the detection of certain chemicals in such fantastically small amounts that most items used in the kitchen, including the most favored spices and other adjuvants to food and drink, could almost certainly be shown to contain detectable levels of chemicals having carcinogenic properties in one or another kind of test system. In this regard, it is entertaining to recall that caffeine was one of the first substances claimed to increase the rate of mutations in bacteria. It will take complex and sophisticated biological and clinical research to develop practical common sense in the evaluation of risk-benefit concepts in nutrition--and to define sensible threshold levels in food additives and other substances such as pesticides and hormones that eventually find their way into most articles of food.

Functional Aspects of Nutrition

As mentioned earlier, the definition of "recommended daily allowance" for the various items of food was derived at first from studies made on normal persons, according to age and sex. It is now realized, however, that there are enormous individual differences, some caused by the genetic constitution, and others by the past history of the particular person, as well as by the occupation and ways of life of that person. The physiological state of the person at a particular time also influences requirements; this is obvious in the case of pregnancy, or during a period of recovery from some debilitating disease. But there are many other situations in which the nutritional state can influence the response of the person to various forms of stress or treatment. Nutritional science would greatly benefit from the development of functional tests designed to measure the ability of the organism to develop scar tissue, to produce antibodies, to generate phagocytic cells, to correct tissue damage, to modify behavior--in brief to make adequate biological and psychological responses to various life situations.

In this regard, it is of interest that production of at least two neurotransmitters by the brain is affected by the nutritional state: serotonin by the concentration of tryptophan, and acetylcholine by that of choline in the blood stream. These are two substances that the body cannot manufacture and that must be supplied in the diet.

Although there is an enormous scientific literature on the relation between nutritional state and susceptibility to infection, only few facts are well established, and the mechanisms involved have rarely been analyzed. Malnutrition increases susceptibility to certain types of infective agents but not to others. Paradoxically, in fact, malnutrition increases resistance to a few pathogens--at least in experimental infections. For example, animals fed a diet somewhat low in paraamino benzoic acid have been shown to be extremely resistant to experimental malaria, probably because plasmodia have high requirements for this substance.

I shall end with another kind of functional response to infection which seems to be profoundly affected by the nutritional state. A few decades ago, numerous tests were carried out by epidemiologists and statisticians to evaluate the protective efficacy of BCG vaccination against tuberculosis in children, but the results differed from one part of the world to another.

For example, tests carried out by English and Scandinavian teams in England and in Scandinavia showed a high level of protection. In contrast, tests carried out by American teams in Indian tribes of the Southwest, in the deep South, and in Jamaica gave little if any evidence of antituberculous protection. It is possible of course that the samples of BCG vaccine used by the various teams differed somewhat in immunizing potency, but it is certain on the other hand that there were great differences between the populations tested. One can take it for granted that most English and Scandinavian children were in a good state of nutrition, whereas malnutrition was prevalent in all the ethnic groups studied by the American teams.

Experiments in mice have revealed that BCG vaccination has very little protective value against intravenous injection with virulent tubercle bacilli when used in animals fed a deficient diet. Although these experiments were not sufficiently developed to reveal the cellular or humoral mechanisms responsible for the failure of BCG vaccination in malnourished animals, they point to the importance of the nutritional state in resistance to mycobacteria.

Conclusions

During its first phase, nutritional science was focused on the identification of essential food factors, the analysis of their chemical structure, the determination of minimum requirements according to age and sex, and to some extent the study of their metabolic role. During the past two decades, emphasis has shifted to the recognition and study of pathological effects produced not only by undernutrition but also and even more by overnutrition.

In my judgment, we are now about to enter a different phase of nutritional science--one based on functional tests determining the role of food not only in growth and disease, but also in the various functions that enable the body and the mind to respond effectively to challenges and stresses in the various manifestations of life. This new phase will require not only physiological studies but also a behavioral approach. It will inevitably bring to light that the human species is as adaptable with regard to nutrition as it is with regard to all other aspects of its needs. There are, of course, biological invariants in the need for food. But to a large extent, human beings can determine what they become and what they are able to do by what they eat, and, vice versa, what they eat influences what they become and what they are able to do. This interplay will in turn raise questions of value that are parascientific. The post-war Japanese are taller than their parents, but this does not mean that they will live longer, be happier or more productive in the arts and sciences.

It seems reasonable to envisage a time when dietary regimens can be designed, not only for growth and health, but for certain functions and cultural values. Nutrition can contribute to a new science--as yet undeveloped--of human ecology.

CONFERENCE ADDRESS

Hale Champion
Under Secretary
Department of Health, Education,
and Welfare

I welcome this opportunity to speak briefly and publicly about nutrition. That may not sound very significant to you, but it is a matter of critical importance to me in my public life and in my private life.

Certainly you must have sensed in recent years that you had the good fortune to be working in an area of inquiry where great scientific interest and a great sense of possibility were meeting with growing public interest and support. For scientists, that sometimes has its problems in terms of public misinterpretation or misunderstanding, but the recent evidence is that you regard those hazards with reasonable equanimity, so long as the support manifests itself adequately at budget time--and we hope it will.

For public officials, especially one in a position such as mine, this happy concatenation of interest and events also has its problems. First, one has to be identified with it, and I have never had the chance to use the word "nutrition" publicly before. It is a great achievement. And I hope you realize how important this is, to hitherto obscure public officials.

There is a private aspect, too. My wife is a sometime chemist who has, in the last few years, taken more than a casual interest in the subject of nutrition. In pursuit of this interest, she has gone back to various universities, and I have spent a number of late evening hours listening to the strange words that describe the strange events that take place in the digestive system and the other systems it serves. To understate the matter, I have had no status in those discussions. But this morning I am having a chance to discuss the matter with the leading investigators in the field, and I am grateful.

I hope you share with me the knowledge of how you can tell when something has reached the peak of importance in public appeal in Washington. It is when everybody in town is claiming jurisdiction. It is when every department or agency or subagency is laying claim to the central role, suggesting enlarged authority, or the necessity to coordinate--under its own leadership, of course. It is when candidates everywhere are trying to get to the head of the line or the top of the ladder, with cries of "too little" or "too late" or complaints of bungling or of misplaced priorities. By those standards, I need hardly tell you that you have arrived.

The nice thing about nutrition is that it truly belongs at the center of attention, and I hope it stays there. And I can think of no better place for you to enjoy it than at the National Institutes of Health and the Department of Health, Education, and Welfare. It is a splendid context: the best governmental science in the world, and the domestic agency where you can best influence health, education, and efforts to aid the poor and vulnerable. How could one even think about the Department of Agriculture in the midst of such opportunity?

Enough. You have more serious business, and it is very serious business. It is first a business of life and death, and it is secondarily but importantly a business of dollars and priorities. It has been asserted that six of the ten leading causes of death in the United States have been linked to our diets.

Much has been said again recently about smoking, much of it by us at HEW, and we intend to continue to say it. But we also intend to say and do more about nutrition. And just as we have begun the process of developing a more aggressive and comprehensive policy on smoking, so are we doing the same in the field of nutrition. It not only makes sense in terms of health. It also makes great financial sense. At a time when taxpaper restiveness is reaching new levels, and Federal health delivery costs have reached an astronomic 12 cents of every tax dollar--not all of it, many of us would agree, well spent--we need both to acquire new information and to apply it in the area of prevention.

President Carter has stressed again and again his conviction that prevention is the key to a successful national health policy, and no area of prevention is more promising than that of nutrition. We need to recognize both the complexities of developing a comprehensive Administration nutrition policy, and the need for a long view, but we also need to use more of what we already know, and to do it now.

At this point, then, we need your counsel and guidance on which ways to go and which priorities to pursue, both short and long term. Secretary Califano and I will be following these proceedings very carefully, and you can be sure that I, at least, will be well advised to listen to your suggestions.

CONFERENCE ADDRESS

Julius Richmond, M.D.
Assistant Secretary for Health
Department of Health, Education,
and Welfare

It is a pleasure for me to have this opportunity to address this conference on "The Biomedical and Behavioral Basis of Clinical Nutrition: A Projection for the 1980s." I feel very comfortable in talking and meeting with you on this topic, since it is only a few short months ago that I was laboring in the clinical vinyard at one of those small universities in New England, this one on the Charles River.

People have asked me how my current tasks differ from those with which I was engaged in the university, and when I am asked that I think of the diversified portfolio I now carry and am reminded of an anecdote the late Dr. Allen Greg, whom many of you will recall as the Vice President for Health Affairs of the Rockefeller Foundation, was very fond of telling. He said he got off the train at Central Station in downtown Tokyo one morning, walked out on the sidewalk, and saw a building across the street with a huge sign on it. It said, "D. Matsumoto and Sons, Forwarding Agents. Your baggage sent in all directions." And that is about the way the Assistant Secretary and Surgeon General feels most days in trying to discharge his responsibilities.

As I looked at the program agenda and contemplated where I have been in the past and where I am now with my current responsibilities, I could not help but be a bit anecdotal and think of the service I was directing at the Children's Hospital in Boston prior to my coming here. We had become interested in the interactions of biology and the environment, in the form of social and psychological issues, which is to say that we were observing the children that we found on the wards, who had what might be defined as psychophysiologic problems, or psychosomatic problems. And I began to think about the clinical clusters that we saw on that service.

The clusters centered around the following: 1) anorexia nervosa, by far the most common diagnosis with which we had children admitted; 2) obesity--severe obesity that was life-threatening in young children; 3) failure to thrive, associated with what Nathan Talbott and his collaborators some years ago referred to as psychosocial dwarfism; 4) a number of chronic disorders such as fibrocystic disease, which offered us a model particularly in early undernutrition to look at the impact of undernutrition on mental development, a naturally occurring model for study; and 5) children with a variety of inborn errors of metabolism, where we were trying to identify the impact of a metabolic defect on psychosocial development.

I mention this because we did not set out, in defining this program, to say that we were studying nutrition, but clearly all the categories that I mentioned had important nutritional components. I mention these somewhat anecdotal observations largely to put the concerns on the biomedical and behavioral aspects of clinical nutrition in a general policy perspective that we have been developing in the Public Health Service and in the Department of Health, Education, and Welfare. It may at times seem that policy just emerges rather than being planned, but I can assure you that the Secretary, the Under Secretary, Dr. Fredrickson and other agency heads, and my staff have thought long and hard about the directions in which we might go in order to improve the health of the American people.

One can identify these directions largely under three categories. First, clearly we can improve health if we improve health services to the unserved or underserved populations. The second direction in which we need to go, if we are going to improve the health record of the American people, is in the direction of prevention; certainly, nutrition is very heavily involved. The third direction is, of course, improving the knowledge base through research.

This conference, therefore, is highly significant to us because, as the Under Secretary indicated, we are dealing with a pervasive issue in terms of human development, human health, and welfare. And in this conference, we will be looking at not only where we have been but where we might be headed.

It is interesting to look at recent history--at the activity, for example, of the Senate Select Committee on Nutrition and Human Needs. A decade or so ago, that committee was focused largely on the issue of hunger within the country, and its reports and deliberations focused largely on those issues. Over the last few years, we have seen a shift--in part because of the very considerable interest throughout our population in nutrition and better health--toward dietary goals and not exclusively hunger. This does not mean that the Senate Committee is no longer concerned with equity and the appropriate distribution of food. It recognizes that dietary goals are important for the low income population, but also realizes that such goals are just as important for the rest of the population.

Clearly, what we are beginning to attend to is not only illness but wellness in our population, and we do this at a time when, by all criteria, our people have never been healthier, whether measured in terms of longevity, infant mortality rates, decline in mortality from cardiovascular disease, or many other indicators of health.

But what I am suggesting in terms of my view of the role of this conference is that it will help us not only to focus on how we can apply the knowledge base that we have in nutrition more productively, but also how we can increase that knowledge base to render our efforts qualitatively more productive.

We have a very rich tradition of biomedical research in this country. The interaction between basic and clinical research has become a very well-developed process. The pattern of clinical investigation, which historically was pioneered particularly at what now is Rockefeller University and adapted to our medical centers throughout the country, and perhaps most clearly and notably adapted here at the Clinical Center of the National Institutes of Health, has been characterized by bringing the basic science knowledge base and skills to the clinical setting, where we find tomorrow's questions, and not only yesterday's questions and programs.

Therefore, we can view this conference as another milestone, it seems to me, in our quest for better definitions of the questions we need to ask in order to make further progress. If we seem, at this point in our history, not to have all the answers, I am reminded of the story told about Gertrude Stein as she lay dying in Paris, with her followers gathered around. She was moaning, "What is the answer? What is the answer?" One of her followers, a little bolder than the rest, stepped forward and said, "But Gertrude, there is no answer." She promptly retorted, "Okay, then what is the question?" I think that is really the challenge before us.

As we look at the program of the conference, the range of issues is very comprehensive indeed. As the Under Secretary indicated, the Secretary and all of us in the Public Health Service are determined to pursue new knowledge and its applications. The Secretary made this very clear in his recent address to the Federation for Clinical Research. We are committed to trying to formulate nutrition policy that will facilitate a better health program for all people. In addition to the work of the NIH Nutrition Coordinating Committee, we have established a Department-wide Nutrition Coordinating Committee to bring our knowledge base into a clearer relationship with our operating programs, and to formulate policies that will not only prevent disease but that will indeed promote health.

I am very pleased to have this opportunity to be with you this morning, to wish you well, and to say once again that we very much look forward to the deliberations of this conference and the guidance that you will provide for us as a consequence of this very historic meeting.

CONFERENCE ADDRESS

The Honorable Henry L. Bellmon
U.S. Senate

Human nutrition research holds great promise for helping to solve some of the serious problems we now face and for helping us to avoid more serious problems in the future. I believe it is fair to say that many members of Congress have been drawn to closer consideration of nutrition as an area of policy development. We are drawn here by necessity. Our interest has been spurred by the growth in health care delivery costs and the belief that these costs can be moderated by closer attention to nutrition and other lifestyle factors.

We have been concerned that so few medical schools have courses in nutrition for physicians in training and for other medical professionals. Two years ago, only nine out of 112 medical schools in this country taught courses identified as human nutrition, and only three or four schools required students to take these formal courses in nutrition. I might say, as a graduate of an agricultural college, that students do not receive degrees in animal science without learning something about nutrition; it is remarkable that in our medical schools we are not training our physicians as well as we are training those who deal with animals.

As legislators, we are aware that citizens desire better nutrition information, and that they are sometimes victimized by fad diets and misleading diet information. Members of Congress are aware that, as a nation, we are seriously over-bedded in our hospitals, which reflects the longstanding emphasis upon treatment, and we know that we face a future with an aging population.

Congress became involved in nutrition with the creation of the Senate Select Committee on Nutrition and Human Needs in 1968; this Select Committee did a phenomenal amount of work in helping to educate the Congress and in helping to bring to the forefront this country's needs in nutrition. The Committee played a central role in raising the awareness of legislators, as well as the general public, about nutrition, and the Committee's work stimulated a great deal of public discussion and professional debate.

The Committee's publication, "Dietary Goals," has been one of the most sought-after Senate documents in history. This document has raised issues that have not been totally free from political fallout. Following the publication of "Dietary Goals," those of us on the Committee heard a great deal from food processors, beef producers, egg producers, sugar manufacturers, and other special groups. Now that the Select Committee has been replaced with the Nutrition Subcommittee of the Senate Committee on Agriculture, Nutrition, and Forestry, it is possible to say that its forceful emphasis on nutrition will not cease.

I might also say that when the fallout from "Dietary Goals" began, the Committee members found themselves in many cases not able to deal adequately with the criticisms that were being made of the report, and it showed us, I think, more than anything else, the need for better nutrition research in the future.

I am personally pleased, and I believe I can speak for most of the members of Congress, to see that the National Institutes of Health is beginning to expand activity in human nutrition research. A growing number of persons in Congress view the research deficit in nutrition and the low level of professional development and expertise in nutrition as a very serious matter. This situation has raised doubts about the ways in which we now apportion research money, determine research priorities, and disseminate the products of research. I believe that members of Congress will continue to be alert during the coming months to the evidence of progress expected of NIH in this significant field. We anticipate that this conference will be only the first step in what we hope is a new direction.

It may be worthwhile to indicate some of the circumstances that make human nutrition important to the citizenry of this country, and therefore to those of us in the political arena. Too often, I suspect, researchers may not have quite the same full access to those outside the intellectual and scientific communities as those of us in the political realm, and therefore they may not have the same sense of importance that is attached by ordinary citizens to various problems that could be solved.

Politicians, on the other hand, are bombarded daily with expressions of concern from constituents, and thus are forced to make decisions about various programs that are intended to solve problems people feel are important. As a matter of fact, politicians may have too much access to the outside world to really take the long look, which those of you in the research area must take, so we may need some kind of hybridization in this area.

One reason why human nutrition is of growing concern to the Congress is that the commitment of the Federal Government to public food and nutrition programs has grown to very sizable proportions. We are presently operating feeding programs that touch the lives of millions of people, yet the effectiveness of these programs has been questioned because of the present incomplete and insecure status of nutrition knowledge and research. We have an enormous opportunity with these programs to benefit human development and health in this country, but we seem to be hampered by inadequate information that could be gained through proper research.

Let me give you some examples of the growth in domestic food and nutrition programs during the last decade. At the present time we are spending about $8-2/3 billion of your money and the money of other taxpayers in this country on these programs. I am not going to list them all; there are about 16 altogether. But if you go back to 1967 and take as an example the Food Stamp Program, we were spending at that time about $105 million. Our budget for fiscal year 1978 is $5.4 billion. The program has gone from $105 million to $5.4 billion in 10 years, and it is programmed or budgeted to go up another $400 million to $5.8 billion next year.

The old Commodity Distribution Program was a larger program back in 1967. It was then costing $101 million; it is now down to $12 million. Thus we have in a large way displaced the Commodity Program with the Food Stamp Program, but whereas the Commodity Program was costing $101 million, the Food Stamp Program is costing $5.8 billion.

The School Lunch Program was budgeted for $150 million in 1967; it is $1.6 billion for FY '78, and will go up to $1.9 billion for FY '79.

We have a new program called WIC [a special supplemental food program for women, infants, and children], which you all know a great deal about. The WIC program was not even in existence in 1967. In FY '78, the cost of the program was $276 million, and next year it will almost double to $535 million. You can see how fast that one is growing.

Taken altogether, the feeding programs in 1967 cost $645 million; in FY '78, they cost $8.6 billion, an increase of more than tenfold, and they will go up by 12 percent to $9.7 billion in FY '79. You can see what an enormous investment of the taxpayers' money we are making in feeding programs. I think you can understand the desire members of Congress have to try to make certain that these dollars are producing the best possible benefits.

Because nutrition research, education, and application are the weak links in public food and nutrition programs, we know that present deficiencies are substantial. There has been considerable criticism of these programs that show where the deficiencies are. From plate waste in school lunch programs to the known failure of some large programs to meet the minimum nutritional requirements, to the lack of information upon which to base feeding programs for the elderly, we are aware that present knowledge and efforts are inadequate.

Quite apart from these public food and nutrition efforts, we know that private citizens need and desire better judgment and guidance in nutrition. Even a casual observer can sense the commercial importance and potential harm of fad diets, of which the liquid protein incident is simply the latest manifestation. Any of you who go to the supermarket will probably notice just at the checkout counter the magazines or the newspapers that are displayed there, and you probably are impressed, as I am, about how often the lead headlines have to do with diet. For instance, I picked up the April 11 issue of the National Enquirer, and the big headline is "The Number One Diet." Another paper called The Star has the headline "Foods to Help You Live Longer." Another one I have before me is called "The One Month Miracle Diet," published in The Midnight Globe.

The people who publish this sort of newspaper do not print these articles for any scientific purpose; they print them to make a buck, and when they can increase their circulation by giving diet information or misinformation such prominent play, I think you can see that there is an enormous desire at the level of those who go through the supermarket checklines to know more about how to eat and, apparently, how to lose weight. I am not suggesting that NIH concentrate research in the weight loss area, but there is a great desire to know more about diet and how to handle food in the best way possible.

In a field hearing before the Senate Nutrition Subcommittee in Oklahoma City, Dr. Jack Metcoff of the Oklahoma University Health Sciences Center told Senator Leahy and me that perhaps 40 percent of hospitalized patients have serious nutritional problems that generally go unattended. Certainly, this represents a very special kind of need for improved nutrition services. Persons who ask their private physicians for guidance about appropriate dietary patterns are most often destined to be disappointed, because most physicians have received little or no training in this vital field.

We in the Congress can initiate physician training programs in nutrition, and I might say we are going to attempt to do that this year, but they will not be very effective unless the knowledge base is substantial and of high and dependable quality. Consumers who wish to maximize the nutritional value of their food purchases need to know more about the nutritional quality of food, but we cannot act to improve labeling, for example, without better information about what food information matters most.

The potential impact of better knowledge about human nutrition upon our present health care system is another reason for growing congressional interest. There are pressures to liberalize our current extensive and expensive health care system, even though total health expenditures have grown to about 10 percent of our gross national product. If present trends continue and we undertake no new government programs, total health expenditures will grow to about $240 billion by 1982, or more than 10 percent of our GNP. The folly of our present system is that it predominantly constitutes an after-the-fact remedy system in which efforts are concentrated on treatment, rather than on prevention or the enhancement of health. As more and more exotic and technical methods of treatment are developed which impact fewer and fewer clinical patients with acute or chronic conditions, the cost of medical care rises without beneficial impact upon the lives of the majority of Americans.

The significance of this system to the growing proportion of older citizens we can expect in the future is twofold: If the later years in one's life are those in which health conditions related to previous errors of lifestyle become the major inhibitor of a full life, then the establishment of sound living habits, including wise nutrition, is an important way to moderate the problem. Second, rising medical care costs now constitute a significant component of inflation, and inflation hits hardest those on fixed incomes such as the elderly.

John Knowles, President of the Rockefeller Foundation, recently wrote an editorial which appeared in Science, and I am sure many of you read it. I would like to repeat here some of the things he said, and I quote:

> "I believe the idea of a 'right' to health should be replaced by that of a moral obligation to preserve one's own health. The individual then has the 'right' to expect help with information, accessible services of good quality, and minimal financial barriers. Meanwhile, the people have been led to believe that national health insurance, more doctors, and greater use of high-cost hospital-based technologies will improve health. Unfortunately, none of them will.
>
> "The individual must realize that perpetuating the present system of high-cost, after-the-fact medicine will only result in higher costs and greater frustration. The next major advances in health of the American people will be determined by what the individual is willing to do for himself and for society at large. If he is willing to follow reasonable rules for healthy living, he can extend his life and enhance his own and the nation's productivity. If he is willing to reassert his authority with his children, he can provide for their optimal mental and physical development. If he participates fully in private and public efforts to reduce the hazards of the environment, he can reduce the causes of premature death and disability. If he is unwilling to do these things, he should stop complaining about the rising costs of medical care and the disproportionate share of the gross national product that is consumed by

> health care. He can either remain the problem or become the solution to it. Beneficent government cannot."

I think the key phrase here is that the individual has the right to expect help with information. I think when people know how they need to live and what the dangers are in some of the lifestyles that have become popular, then, in most cases, they will take corrective action.

While research does not permit simple cause and effect statements to be made for the most part, the relationship between various dietary practices and illnesses such as heart disease, hypertension, digestive difficulties, poor resistance to infection, infant mortality and child development difficulties, obesity, diabetes, cancer, and alcoholism indicate that increased emphasis upon diet as a preventive measure would be highly fruitful.

At the same time that we recognize the potential contribution of improved nutrition to public health, it is important that we do not promise too much. Once again, improved research is the key to providing a clear assessment of the role diets play in well-being. From the estimates we have seen, there is reason to suppose that improved diets would substantially improve public health.

A study made in 1971 by the USDA shows that potential savings in the reduction of deaths or disabilities from various diseases is extremely significant. For instance, it was determined that there could be a 25-percent reduction in those who lose their lives from heart disease if the proper diet were followed; that there could be 20-percent fewer incidences of respiratory diseases; that infant mortality could be reduced by about 50 percent; that obesity could be reduced by 80 percent; that there could be a 20-percent reduction in the incidence of cancer; that 50 percent of diabetes cases could be avoided or improved; and that there could be a 33-percent reduction in alcoholism. I think there can be no doubt that there is a great opportunity for improvement in the health condition of a very large percentage of our population if proper dietary methods were followed.

It is increasingly clear to those of us in Congress who follow scientific research that many scientists regard applied research as a somewhat lower status undertaking than basic research, and that perhaps applied research should not be the primary focus of an organized research effort. I think we would not necessarily agree with that conclusion, if in fact that is your conclusion. We do not quarrel with the worth of basic research. It is perfectly obvious that progress in fundamental knowledge cannot be made without a continuing effort in basic research, but I think it is also perfectly obvious that one cannot move ahead in government unless we get results, and this is where applied research becomes important.

Obviously, we cannot foretell the outcome of basic research, including its applications; it is therefore difficult to schedule basic research activities in terms of anticipated outcomes. I am not suggesting that we discontinue basic research, but our citizens need guidance in the short run, based upon the best that is known from research, including applied research. Most of us do not have the luxury of waiting for a decade or two before we decide how to eat and how to live. When science policymakers short-change applied research and fail to diversify the basic research effort, they act as if it makes no difference what is important to the society that supports those efforts.

I do not think it is a situation where we cannot work together and where we cannot work out the proper mix of basic and applied research. We need to improve the process by which research priorities are set to include the views of those whose destinies do not lie so fully with the scientific community.

When the Nutrition Subcommittee of the Senate recently asked NIH for the amount of money committed to nutrition research in FY '77, we were given a figure of $97 million. Further analysis revealed, however, that this figure contained much basic research that potentially might yield information valuable in the human nutrition area. A more accurate figure representing the extent of the NIH commitment to nutrition research seems to be somewhere between $10 and $40 million. I would hope that we could work out a better way for NIH to report its expenditures and activities to the Congress, so that we in the legislative body will not feel that we are being either uninformed or misinformed. It is entirely possible that NIH will have to rethink its conceptualization of human nutrition research to stress its applied, interdisciplinary nature.

NIH may also have to rethink its focus upon cure as opposed to prevention in biomedical research.

As additional human research is generated, another problem that must be faced is the optimum way of disseminating research findings. With so little known about human nutrition, we cannot afford to be dilatory about disseminating research findings. I do not know if NIH is the best agency for performing that job, but it is a responsibility that cannot be left to chance, and which, I think, can be handled in better ways than is now taking place.

We would hope that the administration will take steps to handle this problem, and that it will clarify responsibilities and coordination between the various Federal agencies that have nutrition assignments.

The process of elevating research and activity in human nutrition promises to be exciting. We need the input of knowledgeable persons to make the effort a successful one. I would hope that those of you who are attending this conference could devise better ways for the Congress to assess our present status insofar as human nutrition knowledge and practice are concerned.

We need to know more specifically the ways in which human nutrition as a discipline has been neglected in the past and can be improved in the future. We need to know how present and projected knowledge about nutrition can be tied to government food and nutrition programs that serve the people. What I am really asking you for is information that will help us spend this almost $9 billion to feed people in a more effective way.

We need to have a clearer plan of action, indicating how best to get from our present status in human nutrition to a more fully and accurately informed state of affairs. Researchers and administrators here at NIH and in the field throughout the country will be the central people in that effort. Your help is needed, and your work will be appreciated by the millions who will benefit from your efforts.

I believe it is time for us to establish an information environment concerning nutrition in this country. This environment must be sufficiently comprehensive and of such high quality that any citizen could take the responsibility for his own nutritional well-being in an effective and safe manner, and be insulated from much of the bad information that is presently being circulated. Those who are not able to do so should have programs competently designed to provide the quality nutrition that is necessary for good health.

I want to assure you that Congress is ready to do its part in this effort, but we need and, in fact, we must have the help of the scientific community, much of which is represented by NIH and a great deal of which is present at this conference.

NATIONAL INSTITUTES OF HEALTH

PROGRAM IN CLINICAL NUTRITION RESEARCH

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National Institutes of Health

The current debate on nutrition and nutrition research has been productive for the National Institutes of Health. It has resulted in a re-examination of NIH activities and the development of methods for better coordinating these activities.

Nutrition research is supported by 11 Institutes and two Divisions at the NIH, and it is coordinated at the Office of the Director, NIH. The 11 Institutes and two Divisions have representatives to the NIH Nutrition Coordinating Committee, and the Committee maintains liaison with other agencies within the Public Health Service, with other parts of the Department of Health, Education, and Welfare, and with the Office of Science and Technology Policy, Executive Office of the President.

FY '77 Accounting

Effective for fiscal year 1977, the Nutrition Coordinating Committee developed a more accurate, comprehensive, and sophisticated method of accounting its nutrition expenditures. In previous years, problems arose because the various Institutes were using differing methods involving "primary or secondary" nutrition, "major or minor" nutrition, or "direct and indirect" terminology for nutrition. As a result, several disagreements and misunderstandings arose. The new accounting method developed for FY '77 is based on: 1) an agreed-upon definition of nutrition research by all the Institutes within the NIH; 2) actual nutrition dollars reporting; and 3) a more detailed listing of areas of expenditures.

First the definition of nutrition research at the NIH:

> "The term nutrition research includes studies designed to assess the consequences of food or nutrient intake and utilization in the intact organism, including man, and the metabolic and behavioral mechanisms

> involved. These studies encompass investigation of nutrient variables at the cellular or subcellular level. This definition also includes:
>
> - Research designed to elucidate the metabolic role or function of nutrients in both animal models and man.
> - All studies concerned with genetic-nutrient-environmental interactions where a nutrient is a variable.
> - Dietary studies expected to produce significant changes in health status, including the maintenance of health and the treatment of disease in man. Such studies might include clinical trials, epidemiological studies, metabolic studies, surveillance, and nutritional status monitoring studies."

Second, all figures are actual nutrition dollars. This means that all nutrition projects are reviewed, and a decision is made as to the percentage of the project that is applicable to nutrition. Therefore, if the total award for a particular project is $100,000 and the nutrition component is assessed at 30 percent, the amount in actual nutrition dollars is $30,000.

Third, the more detailed list of areas of expenditures enables the NIH to pinpoint exactly how much is being spent in any of several important areas. The examination includes looking at the extramural research support (in terms of research grants, program projects, contracts, centers, clinical trials, reimbursement agreements, and training), intramural research, and specifically at the role of nutrition in relation to prevention, genetics, behavioral studies, and international studies.

Biomedical Nutrition Research

Overall nutrition research at the NIH encompasses the role of nutrients on human growth and development, health maintenance, health promotion, disease prevention, and disease treatment. Although the primary mission of the NIH is in biomedical and behavioral nutrition research and research training, nutrition education for the public is an integral part of many programs, leading to the development of nutrition pamphlets, public service announcements on radio and television, and magazine articles. Nutrition education for professionals is provided through various scientific publications, conferences, and workshops.

The NICHD and the NIA programs are oriented largely toward normal development and disease prevention. The nutritional requirements of the pregnant woman and the fetus, transfer of nutrients across the placenta, infant feeding, and the nutritional requirements of the pregnant adolescent are studied by the NICHD. The NIA is interested in the nutritional requirements of the elderly and how feeding habits and patterns early in life affect the aging process. The NIAMDD also supports research on the role of nutrients on health promotion and on human growth and development.

The NHLBI, NIAMDD, and NICHD support food consumption studies on dietary patterns of population groups and factors affecting appetite and food behavior. Furthermore, studies involve all age groups and include the fetus. This approach includes behavioral research both in terms of dietary habits and how various diets (high protein or high carbohydrate) influence the level of neurotransmitters.

Institutes with mandates in categorical diseases have important efforts in nutrition and disease prevention in their programs. Thus, the NCI, NIDR, NHLBI, and NEI support extensive nutrition research programs in their areas of responsibility: diet and cancer, nutrition and dental caries, diet and heart disease, hypertension, and nutrition and various eye diseases, particularly vitamin A deficiency.

The NIH program in clinical nutrition includes epidemiologic research and clinical trials. Epidemiology is an important component of most NIH programs. Many Institutes have Epidemiology and Biometry Branches that carry out epidemiologic research through their own staff or through support to persons in the scientific community. Examples of nutritional epidemiology include:

- Nutritional status survey among Indian groups in Guatemala

- Prospective epidemiologic study of dietary protein and cancer incidence

- Relationship of feeding programs to incidence of infectious diseases among children in Latin America

- Effect of nutritional status on the incidence of cancer

- Evaluation of cancer dietary epidemiological procedures

- Correlations with food intake patterns in international migrant populations

Human nutrition research is indeed unique at NIH. Through sophisticated studies in biochemistry, physiology, and cell biology, NIH-supported research aims at elucidating fundamental mechanisms at the subcellular and molecular levels that have great importance to human nutrition. The discovery of the membrane receptors for low-density lipoproteins and their relationship to the control of cholesterol synthesis is one of the notable strides yet to be integrated into individual capacity for handling milk, butter, and eggs.

The Division of Research Resources (DRR) at the NIH, through its General Clinical Research Center Programs, supports research facilities, laboratories, professional nursing, and dietary personnel essential to clinical investigation in nutrition. The 82 Clinical Research Centers throughout the country provide an effective resource for the interdisciplinary approach to study the clinical manifestations of American dietary patterns. The scope of nutrition research in the Clinical Research Centers includes studies on obesity, diabetes, cancer, parenteral nutrition, hyperlipidemias, atherosclerosis, vitamins, and environmental health factors. Because of this large variety of projects, the Clinical Research Centers are instrumental in the integration of many disparate avenues of research resulting in the most effective methodology of health care. The Clinical Research Centers relate to categorical centers for research in hypertension, diabetes, and cancer.

The team approach in clinical investigation allows the basic scientists, clinicians, dietitians, and nurses to interact in developing a systematic methodology for nutrition research. Most of these centers have evolved from Divisions of Metabolism in the Departments of Medicine.

NIH Obligations in Nutrition -- FY '77

I shall briefly describe the NIH program in biomedical and behavioral nutrition research and training, first by mechanism of support, and then will describe for you the special areas of interest in the program.

Table 1 indicates the NIH obligations in nutrition research and training for FY '77. The total for the year was $93.3 million, which represents 3.7% of the entire NIH appropriation.

a. Extramural Research

The NIH supported 839 research grants in FY '77 for a total expenditure of over $38 million. This category thus constitutes the largest single area of support and is initiated entirely by investigators outside the NIH. Program projects are an additional area of investigator-initiated research. In FY '77, the NIH supported 45 such projects at a total cost of nearly $9 million. With a combined total in the two categories of over $47 million, it can be seen that the majority of the research supported by the NIH in nutrition is initiated by investigators in the scientific community.

Table 1

National Institutes of Health

BIOMEDICAL AND BEHAVIORAL NUTRITION RESEARCH AND TRAINING -- FY '77

(in thousands of dollars)

Item	Breakdown		Total	
	Number	Cost	Number	Cost
Extramural				
Research grants: Regular	814	$36,741		
Clinical trials	25	1,596		
Total			839	$ 38,337
Program projects: Regular	38	7,969		
Clinical trials	7	959		
Total			45	8,928
Contracts: Regular	61	10,206		
Clinical trials	61	5,824		
Total			122	16,030
Centers: Regular	46	8,322		
Clinical trials	8	1,203		
Total			54	9,525
Research support				10,000
Reimbursement agreements			3	460
Training: Training grants	150*	1,643		
Fellowships	32*	418		
Total			182*	2,061
Research career development awards			24*	728
New, young, and academic investigator awards			6*	179
Subtotal - Extramural				$ 86,248
Intramural				
Projects			64	$ 6,456
Training			23*	642
Subtotal - Intramural				$ 7,098
TOTAL NUTRITION RESEARCH AND TRAINING - NIH				$ 93,346

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*Number of persons.

Contracts and centers represent research initiated by the agency. In FY '77, 122 contracts at $16 million and 54 centers at $9.5 million were funded for a total of over $25 million in agency-initiated research in nutrition.

In each of the above four categories, clinical trials have been specifically considered. In FY '77, 101 clinical trials in nutrition were funded at a total cost of over $9.5 million.

Research support provided by the Division of Research Resources is estimated, as accurately as possible, at $10 million for FY '77. This is the only estimated figure in the FY '77 nutrition budget.

NIH also supports nutrition research through reimbursement agreements. Such agreements refer to money given to other agencies by NIH; for example, funds are been given to USDA to develop more complete tables on food composition. In FY '77, nearly $0.5 million was spent in this area.

b. Intramural Research

As shown in Table 1, intramural research in nutrition for FY '77 amounted to $6,456,000.

The NIH intramural program in biomedical and behavioral nutrition research is carried out by the NCI, NEI, NHLBI, NIA, NIAMDD, NICHD, NIDR, NIEHS, and the Division of Research Services. Most of the research is conducted at the NIH campus in Bethesda. However, the NIA's program is located at the Gerontology Research Center in Baltimore, and the NIEHS conducts its research at Research Triangle Park, North Carolina.

The research projects include studies on the metabolism of nutrients, food toxicity, animal studies and animal models, metabolic studies on normal volunteers and patients with various disease states, prospective randomized studies, U.S. Cancer Mortality Survey, and longitudinal studies. For example, a rather impressive longitudinal study of human aging is conducted at the Gerontology Research Center in Baltimore; this intensive multidisciplinary study includes an evaluation of nutritional factors and is aimed at assessing the role of controllable variables in the life history of the participants. More than 1,000 men have been studied, ranging in age from the early 20s into the 90s. Their return at 1- to 2-year intervals and their 2-1/2-day visits generate the data that will permit an assessment of the role of nutrients in the development and prevention of age-associated diseases and in the rate of change with time in physical, physiological, biological, and intellecutal functions.

c. Nutrition Research Training

The NIH supports training in biomedical and behavioral nutrition in both the extramural and the intramural programs.

Within the extramural program, two basic mechanisms are used for nutrition training support: institutional awards and individual awards.

The Institutional National Research Service Awards, commonly called "training grants," are designed to enable institutions to make training awards to individuals selected by them for predoctoral and postdoctoral research training in nutrition. In FY '77, this mechanism was used to train 28 MDs, 36 PhDs, and 86 predoctoral candidates in nutrition, for a total of 150 persons at an obligation of $1,643,000.

The Postdoctoral Individual National Research Service Awards, called "fellowships," are awarded to provide postdoctoral research training to individuals to broaden their scientific background and extend their potential for research in nutrition. In FY '77, the NIH supported 10 MDs and 22 PhDs in nutrition for a total of 32 persons at $418,000.

Therefore, in the extramural nutrition training program for FY '77, including both training grants and fellowships, a total of 182 persons were supported (38 MDs, 58 PhDs, and 86 predoctoral candidates) at an obligation of $2,061,000.

The areas in which the various trainees carried out their work include the following: 1) food; 2) nutrition and various specialities; and 3) various studies in nutrient metabolism. Food studies include: food contamination and its mutagenic potential; methylbenzyl nitrosamine (as esophageal carcinogen and food contaminant); adaptation of rat mammary tumor model to study modulating influences of diet; recovery of feeding behavior following brain damage; effect of peptide hormones on food intake and body weight; effeciency of food utilization during tissue repletion; and the nature of feeding (e.g., induced rhythmicity in intestines' enzyme rate-limiting cholesterol metabolism). Studies on nutrition and the various specialities include: biochemistry and metabolism; gastroenterology; burns and trauma; pediatrics; energy metabolism and exercise physiology; lipid metabolism; the oral mucous membranes; oral biology; carcinogenesis; and endocrine physiology. Studies in nutrient metabolism include: mechanisms of action of neonatal effects of diethylstilbesterol on the development of estrogen receptors; neurotoxic effects of plumbism in rats; influence of dietary protein on control of food intake; metabolism of 1,25-dihydroxy vitamin D_3; nutritional effects of polymorphonuclear functions; zinc metabolism in isolated liver parenchymal cells; control of lipogenesis and obesity; dietary, hormonal, and genetic determinants of obesity; effects of lecithin feeding on lipids and lipoproteins;

effects of alcohol on lipoproteins in normal and hyperlipidemic individuals; effect of acute and chronic vitamin C deficiency on fat metabolism; long-term effects of total and partial vagotomy on growth and food intake of rats; effect of dietary fat on composition and size of primate very low density lipoproteins; chylomicron remnants in cholesterol-fed rats; in vitro metabolism of nutritionally deprived epithelia; oral science nutrition and metabolism; lead metabolism and hepatitis; nutritional control of fat oxidation in cancerous mice; intestinal bacterial and nitrosamine formation in vivo; and biosynthesis of aflatoxins.

Within the NIH intramural program, two Institutes--NIAMDD and NICHD--supported a total of 23 scientists at a cost of $642,000 in their FY '77 training programs in nutrition.

NIAMDD trainees are working in the following areas: nutrition and metabolism of fat-soluble vitamins; liver and intestinal lipoprotein metabolism; folic acid enyzmes; hormonal effects of obesity; gastrointestinal hormones and pancreatic secretion; and diabetes and gall bladder.

NICHD trainees are working in such areas as the following: obesity in children; Ca++ balance in children; growth retardation in children with cystinosis; model system of B and T cells in vivo and in vitro with regard to hormone and nutrient effects on protein synthesis; hyperglycinemia and studies of dietary amelioration; placental transport of melatonin and its influence on fetal nutrition and growth; growth retardation in children with cystinosis; trasduction of chromosomes by liposomes to correct PKU, galactosemia, and other inborn errors of metabolism; progress of crypt cells to brush border cell by using sucrase as a marker; the effect of melatonin on nutrition and development of the fetus; cystinosis studies, including nutritional studies of fibroblasts exposed to high and low levels of cysteine; and Ca++ balance studies in premature infants and small-for-gestational-age infants.

In the combined extramural and intramural training programs in nutrition, the NIH supported a total of 205 persons for an obligation of $2,703,000 in FY '77.

d. Manpower Research

A special area of support in nutrition by the NIH is that of manpower research through the mechanisms of Research Career Development Awards (RCDAs) and Young Investigator Awards. RCDAs are awarded to enhance the career development of outstanding scientists with clear research potential or demonstrated capacity for independent research who require additional training and experience in a productive scientific environment in preparation for careers in independent research. Young Investigator Awards are issued through several mechanisms: 1) to support basic and clinical studies so newly trained investigators remain active during the developmental stage of their careers; 2) to create and encourage a stimulating approach to disease curricula that will attract high-quality students, foster academic career development of promising young teacher-investigators, develop and implement excellent multidisciplinary curricula through interchange of ideas, and enable the grantee institution to strengthen its existing teaching program; and 3) to provide the opportunity for promising medical scientists or faculty members who will pursue research in nutrition and aid in filling the important academic faculty gap within health professional institutions.

In FY '77, 24 RCDAs were awarded in nutrition at an obligation of $728,000, and six Young Investigator Awards were made at $179,000.

The areas under study in these special categories of manpower research include the following: behavioral cardiovascular compliance strategies; chemical studies in growth and development; nutrition and behavior; nutrition and cell growth; metabolic derangements from galactose toxicity; genetic control of membrane transport and metabolism; endocrine regulation of carbohydrate metabolism; placental transport of vitamin B_{12}; maternal malnutrition and transfer of nutrients; fatty acid synthesis in vivo and in culture; relationship between nutrition and carcinogenesis; atherogenesis and lipid metabolism; new diet treatment in diabetes and obesity; control of enzymes in vitamin D_3 endocrine complex; regulation of food intake and body fat; exercise and lipid metabolism; metabolic effects of diet and meal pattern; experimental obesity--genetic and acquired; glycerol 3-P dehydrogenase and egg yolk avidin; nutritional therapy of uremia; sensory physiology in health and disease; nutrition and the oral mucous membranes; and biochemistry of oral tissues.

Special Interest Areas in Nutrition

Biomedical and behavioral nutrition is a complex science, encompassing many aspects. Certain of these aspects, however, are of particular importance and are considered by the NCC to merit special attention. I will therefore describe the efforts undertaken in the following special-interest categories: nutrition and prevention of disease; genetics and nutrition; behavioral studies in nutrition, and international activities in nutrition.

a. Nutrition and Prevention of Disease

Nutrition studies aimed at the prevention of disease constitute a major portion of the nutrition research program at the NIH. Of the entire NIH nutrition budget for FY '77, 40% (or $38 million) was devoted to disease prevention. All the Institutes (except NIAID and NINCDS) have studies in this category. The mechanisms in nutrition and prevention for FY '77 included 338 research grants, 29 program projects, 69 contracts, and 38 centers.

Much of the NIH-supported nutrition research is directed toward obtaining knowledge to show how abnormal conditions and diseases may be prevented. This includes studies relating to control of body weight, nutritional status assessment, nutrient intake methodology, nutritional requirements, bioavailability of nutrients, role of dietary fiber and trace elements, digestion, transport, and regulation of nutrients in the body. Specific prevention studies of particular interest are described below.

Several studies focus on dietary factors that may be associated with various forms of cancer. The factors may be nutrients as well as non-nutrients (e.g., fiber) or mycotoxins that can occur naturally or as contaminants or food additives.

In the prevention and control of eye diseases, the most striking disease grouping involving nutritional deficiency is keratomalacia/xerophthalmia, which is a clinical entity primarily of vitamin A deficiency but which includes protein-calorie malnutrition (of special interest in international health). Present studies use vitamin A in a vehicle that would result in eradication of the disease. Other eye disease prevention studies are concerned with the use of flavonoids in retarding cataract development, vitamin C in corneal diseases, and vitamins E and B_{12} in controlling certain diseases of the retina.

Other NIH-supported studies involve dietary control as a means of preventing such conditions as high blood pressure, arteriosclerosis, mental retardation, impaired immunity, obesity, and dental caries. Additional studies are concerned with the effects of dietary modification on longevity, on mitigating pain, in speeding recovery of patients, and on treatment of post-traumatic infections.

b. Genetics and Nutrition

In the genetics and nutrition program at the NIH, the effects of nutrition and dietary intervention on inherited diseases and conditions are studied in 38 research grants, 2 program projects, 11 contracts, and 5 centers for a total obligation of over $5 million in FY '77. Seven Institutes are involved in these genetics and nutrition studies: NCI, NHLBI, NIAMDD, NICHD, NIEHS, NIGMS, and NINCDS.

Genetics and nutrition research at the NIH is concerned with such areas as: inborn errors of metabolism; determinations of cellular function, especially DNA repair mechanisms under nutritional stress; chromosomal aberrations; protein synthesis; metabolic disorders; obesity; and the role of dietary control in inherited diseases, including hyperlipoproteinemia, diabetes, sickle cell anemia, and chondrodysplasia.

c. Behavioral Studies in Nutrition

The NIH FY '77 funding level for behavioral studies in nutrition was over $12.3 million, and consisted of 41 research grants, 7 program projects, 50 contracts, and 5 centers. Studies were supported by eight Institutes: NCI, NHLBI, NIA, NIAMDD, NICHD, NIEHS, NIGMS, and NINCDS.

Behavioral studies in nutrition are various and complex, with little overlap between Institutes:

- Identification of behavioral factors that influence probability of cancer development.
- Application of behavior modification techniques to allow cancer patients to consume diets that meet nutritional requirements.
- Utilization of behavioral modification, for high-risk persons and the general public, regarding dietary factors in cardiovascular diseases.
- Changes in taste and smell with age and the influence of caloric restriction on modifying central nervous system mediated behavioral responses.
- Feeding behavior related to obesity, particularly the mechanisms involved in physiological or psychological appetite and ingestive behavior.
- The effects of malnutrition on behavior.
- Behavioral effects of acute and chronic cadmium administration.
- Behavioral functions affecting changes in bodily fluid, feelings of satiation, and defense reactions.

d. International Activities in Nutrition

The NIH, with an FY '77 funding level of nearly $2.7 million, supported 15 research grants and 8 contracts in nutrition studies abroad. International activities are underway in several countries, including Japan, Iran, Chile, Norway, Colombia, Canada, the Pacific basin, Soviet Union, Israel, and Bangladesh. Five Institutes support international nutrition activities: NCI, NHLBI, NIAID, NIAMDD, and NICHD.

Specific research programs include investigations on the following: environmental conditions, including nutrition, that lead to an unusually high or low incidence of cancer; the prevalence of lipid diseases and their association with diet and cardiovascular disease in defined populations; and the role of malnutrition in susceptibility to infection, in immune response, and in various aspects of human development.

A major international activity is NIH support to the Malnutrition Panel of the U.S.-Japan Cooperative Medical Science Program. The objectives of the Panel are: 1) determination of the effects of nutrition on physical and mental development, behavior, physical capability, and work performance; 2) studies of the health significance of iron deficiency and methods for its eradication; 3) influence of environmental and host factors on health requirements; 4) investigation of the interactions of nutrition and infection; and 5) health consequences of different, and changing, dietary patterns and food habits.

Recent Activities in Nutrition

The NIH is most pleased with the response to the NICHD Request for Applications (RFA) on infant nutrition studies. The Institute received 200 letters of intent by the end of January 1978, and 80 applications by the beginning of March. These applications will be considered by the NICHD Advisory Council in October 1978. The NICHD is augmenting its research support in infant nutrition, including research on the composition of breast milk.

A major portion of research on food habits is expected to evolve from the NICHD program on clinical nutrition and early development, which is now underway. This new program will extend the Institute's current biomedical effort in nutrition research into behavioral, social, and cultural influences on nutrition as these relate to the promotion of health and prevention of disease. An important aspect of the new program will be the study of food habits and food avoidances during pregnancy and lactation in order to improve the health of the mother and her infant.

The NIA has begun its program in clinical nutrition. The NIA's RFA in clinical nutrition for the aged elicited more than 300 inquiries. Grant applications resulting from the RFA will be reviewed in October 1978. To assist the NIA in developing its program in clinical nutrition, the Institute sponsored in June 1978 the conference on "Nutritional Needs and the Health of the Aging Adult."

Negotiations are proceeding between NIA and the National Center for Health Statistics (NCHS) to study the nutritional status of the elderly. Procedures are being developed to follow up cohorts that were examined in previous nutrition surveys by the NCHS.

Finally, the NIH Nutrition Coordinating Committee is in the process of developing a joint Program Announcement on obesity. Several Institutes with mutual interest in obesity will be soliciting grant applications for the support of research in the biomedical and behavioral aspects of exogenous obesity.

Future Directions

The NIH is exploring the establishment of Clinical Nutrition Research Units, both within the Clinical Center and in institutions across the country. CNRUs would provide a central focus for clinical human nutrition research and training in one or more specific clinical or basic science areas that will enhance the opportunitites for clinical research experience and training of medical personnel in nutrition. The CNRUs should stimulate the development of improved methodologies in systems of assessment of nutritional status and treatment of patients in order to encourage the application of appropriate measures in nutritional health care, particularly of hypermetabolic patients, and to increase efforts to provide nutrition education to patients of all sorts.

An additional area of particular emphasis will be in training. In its combined extramural and intramural programs, the NIH was training only 205 persons in nutrition in FY '77. Attempts will be made to expand this training program.

In conclusion, the following quotation from Dr. Donald Fredrickson's presentation at the Food and Nutrition Board annual meeting in December 1977 is appropriate:

> "I should remind you that the goals of nutrition research in this country, as carried out by NIH, are largely determined by the scientific community. This is to say, that by far the largest part of our nutrition program is carried out through the regular grant program, and that the projects which are funded are largely based on peer review and on a determination of scientific excellence by our own peer review committees. It could be that there needs to be some interference with this 'normal' traditional process. In some areas, targeting and determination of high program relevance already add coefficients to the market conditions set by the peer review priorities. It is important for the nutritional community to marshall arguments for moving away from investigator-initiated research to emphasis on targeted or contract support, or even to center-concept funding, if indeed this both serves more immediate national needs and enhances opportunity for discovery. NIH is prepared to listen carefully in the public interest and most thoughtfully to such discussions."

FOOD AND DRUG ADMINISTRATION

PROGRAM IN NUTRITION

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Although the relationship between diet and health has been recognized since prehistoric times, it was only with the elegant and germinal work of Antoine Lavosier on dietary energy, oxidation, heat and life that this relationship was established on a base of solid scientific evidence. Since Lavosier, nutrition has evolved through several phases, each reaffirming the fact that nutrition is a derived science, dependent upon the information developed in the more fundamental sciences for its foundation.

With Lavosier, nutrition began the great series of studies that confirmed and affirmed the interaction between body substance and diet, the Vas Monest concept. This phase passed into the next or chemical phase with the explosion of organic chemistry in the 19th century. The discovery and identification of vitamins and amino acids, the revelation of the chemical nature of the macronutrients, and the recognition of the need for inorganic substances in the diet led to the development of the nutrient "super pill" concept of nutrition. With the evolution of molecular biology and its insights into the fundamental nature of life, about 10 years ago nutrition entered into a pseudometaphysical stage from which questions are now being asked concerning the interaction of diet with fundamental life processes and the profound consequences of the derangement of these interactions.

Much of what we believed in 1950 is now being challenged. More important, as nutrition science moved from questions of survival and deficiency to those of quality of life and balance among nutrients, the goal of nutrition research in regulatory agencies such as FDA has shifted from one of assurance of levels of nutrients and absence of toxicity to definitions of adequate patterns of nutrients and the elucidation of the consequences of imbalance on cellular processes, hoping in this way to provide for maintenance of health from conception to death.

Although FDA, through its concern over the assurance of a safe food supply, has had since its formation in 1906 an interest in nutrition, it was not until 1938 that it initiated a formal nutrition program. This initiative resulted from the establishment of a national policy for the fortification of basic staple foods, itself a result of the chemical era concept of chemical solutions to public health problems.

To assure the validity of nutritional claims on food labels, the agency developed a competence in nutrient analysis as well as a research program designed to support this effort. With widening areas of responsibility defined by congressional action and administrative regulation, the research effort of FDA also had to expand. Today it represents one of the major areas of concern in the Bureau of Foods, involving nearly $4 million and over 110 man-years of effort.

In general, the FDA research effort in nutrition is directed toward the support of three basic regulatory areas. These have been defined by the Commissioner as follows: 1) to maintain and improve the nutritional quality of the national food supply, particularly in the face of changes brought about by increased reliance on processed foods; 2) to foster the application of modern nutritional principles to the management of disease and injury; and 3) to improve awareness and understanding of nutrition by consumers.

To accomplish these tasks, the agency applies nutrition knowledge to specific health questions, develops consumer information and education models, initiates regulations concerned with nutritional quality, and evaluates nutritional claims for their validity and effects on health.

The nature of these problems faced by FDA requires the establishment of an appropriate foundation of scientific fact for their solution. Equally, it requires an effective strategy by which modern nutritional technology can be transferred most appropriately to the public in the form of both new products and, more importantly, information that enables the consumer to make informed choices.

The research program supporting these efforts utilizes a complex of intramural research, contracts, and collaborative efforts with other agencies and institutions. It tends to be rather diffuse, since it is based upon responses to immediate crises and short-term perceptions of the impact of technology on nutritional needs. In general, the program may be described in several segments, each containing a group of generally related research projects.

The most fundamental of these are those concerned with the establishment of levels of nutrients necessary to meet human needs under a variety of environmental conditions. Assurance that such levels will not result in chronic toxicity in man are a vital adjunct to this research. These studies include defining the impact of both deficiency and excess of such trace elements as zinc and iron on the health and behavior of man, the impact of high levels of such vitamins as A, E, D, and ascorbic acid on the occurrence of degenerative diseases, and the impact of high levels of fiber, free amino acids, and digestible carbohydrates on the absorption metabolism of other nutrients, as well as on the effectiveness of medically important foods.

Studies of nutrient interrelationships, particularly those concerned with disease prevention, are also of fundamental importance and include such areas as the impact of high phosphorous levels in the food supply and the occurrence of osteoporosis from calcium loss, or the impact of high levels of zinc on copper metabolism and the impact of high levels of protein on calcium metabolism.

Another area is concerned with bioavailability of nutrients and the assessment of nutrient quality and is designed to provide information for setting standards of quality for foods regulated by FDA. Such studies include development of methodology for assessing bioavailability of nutrient quality and the establishment of specifications for nutrients used for fortification and establishment of nutritional quality specifications for fabricated foods.

Similarly, assessment of medical foods involves both the evaluation of the effectiveness with which such foods aid in the dietary management of disease, as well as the establishment of specifications for these foods.

A fourth program is directed toward food composition and nutrient analysis. It is designed to provide the agency with information necessary for evaluating nutrition information in labeling, assessing changes in the nutrient quality of the food supply, establishing fortification policy, and in general enforcing compliance with the Food, Drug, and Cosmetic Act and its implementing regulations. It includes method development, surveillance, compliance, analysis, and so on.

Research involving consumer studies comprises a fifth area. It includes assessment of consumer knowledge, measurement of the consumer's perceived needs for information, and develoment of model education information systems.

While much of this effort is conducted in-house and on contract with various institutions, a significant proportion of the work is part of the major collaborative effort that the FDA has maintained through the years. These collaborations are largely concerned with issues such as labeling, nutrition information, surveillance, and food consumption data, and involve agencies such as the National Institutes of Health (NIH), the Center for Disease Control (CDC), the National Center for Health Statistics (NCHS), the Federal Trade Commission (FTC), and the U.S. Department of Agriculture (USDA). In addition, the agency has depended almost exclusively on NIH and USDA to provide the basic information it requires for the development of its programs.

Finally, some mention should be made of the HEW-USDA proposal to establish a national comprehensive Nutritional Status Monitoring System, which will attempt to maintain and continuously update information on the health of the American people in relation to the diet they consume.

In support of this program, a comprehensive and far-reaching series of research initiatives has been included, ranging from the development of basic nutrition information for establishing nutritional indices of all phases of life under nearly all physiological states, to the development of screening tools that are specific, sensitive, and cost-effective. Probably the most important aspect of this proposal is the extensive effectiveness evaluation component--one of the first to be included as an integral part of such a project. FDA is involved in practically every facet of this enterprise, the magnitude of which will make a considerable impact on the agency's research effort.

In spite of its diversity and complexity, one may ask if this FDA program, laboriously and painstakingly developed and matured since 1938, does indeed meet the needs of a regulatory agency in the fourth quarter of the 20th century. More important, does it provide for the needs of the next 25 years? As mentioned earlier, the program is largely involved in response to crisis or to congressional action. With limited resources, particularly in people, not much effort could be devoted to more philosophical questions of how best to utilize 20th century science or how to develop predictive models of nutrient need. The amazing thing is not necessarily the diffuse, pragmatic nature of the FDA nutrition program, but rather that a program exists at all, given the funding situation of the past several years.

The increasing capability to fabricate new foods, having specific nutrient advantages, raises essential issues of imbalance and multiple generation effects never before considered. Clearly, traditional empirical approaches to such problems are no longer adequate. What is needed is understanding of the basic processes involved, definition of the critical points of regulation, and the mechanisms by which diet can modify these processes. With this information, predictive models can be developed and prescriptive decisions can be reached without the immediate necessity of extensive empirical studies. It seems clear from this analysis that a new program in research is required by the FDA.

As part of the overall evaluation and construction of an aggressive research program for the Bureau of Foods, work has started to explore the areas of research needed for the agency to fulfill its mission in nutrition for the remainder of the 20th century. Among the many areas proposed, several stand out in terms of their particular importance. The problems of understanding and predicting nutrient toxicity, both individually and collectively, seem particuarly troublesome in the area of the meganutrient program.

For these problems, several areas of research need development, including metabolic patterns, immunocompetence, modification of developments, and so on. The development of special toxicity testing models suitable for low-level toxic substances that at some level are essential for life represents an additional area of concern. Given the nature of 20th century life, consideration must also be given to interaction of nutrients with drugs, food additives, environmental contaminants, smoking, alcohol, an entire shopping list of substances.

On the other hand, much more information is required to delineate the expression of toxicity to contaminants in self-abuse situations such as smoking and drug use to nutritional states. In the area of bioavailability, the effect of genetic factors, environment, life cycles, disease, and energy on the utilization, transport, and absorption of nutrients is also of concern.

Equally important is the development of better epidemiological survey and surveillance techniques to permit more accurate monitoring of the nutritional status of the population and the national food supply, and to predict areas of potential problems prior to their becoming crises. New epidemiological approaches are required to define the scope and magnitude of current nutritional problems and to identify susceptible population groups. And with this information, surveillance of susceptible groups, such as adolescents and the elderly, can be targeted for special study.

We need a better understanding of consumer perception of food and the attitudes toward changes in the food supply. We also need to have better understanding of how and why consumers read labels and what they really want to see there.

Of all these, however, the most important may be in the area of behavior and central nervous system development and function. Although we have recognized the relationship between dietary adequacy and central nervous system development for about 20 years, the more subtle regulatory significance of these observations has not yet been realized. The implication of this work suggests that diet may indeed modify behavior in many important ways.

Not only are questions asked concerning learning, but issues of emotionality, adaptation, and perception may also be raised. For example, is obesity in part a taste perceptual deficit conditioned by early diet? Recent work on the use of several nutrients such as tryptophan and choline in the therapy of certain central nervous system pathologies also raises the question of functional significance. What are the behavioral consequences of megadose use of these nutrients? Do they have long-term significance? Or, to put it more speculatively, can mood be modified by diet? If so, can it be abused?

The solution of such problems of fundamental significance requires better understanding of behavior and central nervous system function, of neurotransmitter metabolism regulation, and, most important, of the interaction of diet with these functions.

In summary then, a program designed to provide FDA with the capability to predict and deal with the nutritional problems of the last quarter of the 20th century must have several components: 1) knowledge of the essential regulatory points of metabolism, susceptible to modification by diet; 2) an understanding of the changes in these critical points produced by development, environment, and physiological state; 3) mechanisms to identify susceptible populations and to maintain surveillance of their dietary patterns and nutritional state; and 4) understanding of the forces that direct the consumer to specific food choices and the best mechanisms to promote the most nutritionally optimal food choices.

Such a program must have built-in extensive flexibility. Even in an applied and action-oriented agency such as FDA, recognition of serendipity and the unpredictability of human events makes a rigid and too-structured program not desirable. Moreover, the care and feeding of innovative and productive scientists demand it.

It is obvious that the accomplishment of all these research goals is beyond the resources of FDA, even if it were desirable for the agency to attempt it. The agency will again depend on contracts and collaboration to extend its intramural capabilities. However, to these will be added a new grants program designed to provide information and insights in areas requiring a research approach less structured than that permitted by the traditional contract program. We will continue to depend on other agencies such as NIH and USDA to provide the fundamental information we require to formulate FDA programs.

However, FDA will not feel constrained by any artificial distinctions between basic and applied science if such information is not available nor programmed by others. Nutrition is, after all, a problem set; or, as Jean Mayer defined it, an agenda of problems, the solution of which requires the application of all man's knowledge and technology. For FDA to solve its share of the agenda, it must obtain from others, or by its own efforts, the science it requires. Our efforts will not be restricted by any of these artificial distinctions but, rather, will follow the dictum elegantly enunciated by Louis Pasteur: "There is not basic science or applied science, only good science and bad science." In pursuit of our mandate to maintain and protect the health of the American public, our only restrictions will be those enforced by the former; that is, good science.

DEPARTMENT OF DEFENSE

PROGRAM IN NUTRITION

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The Department of Defense Manual 1338.10-M is the basic document delineating responsibility for food and nutrition research. A provision of the implementing joint regulation entitled "DOD Food Research Development, Testing, and Engineering Program," which was first published in 1971, indicates that the Surgeon General, Army, will serve as a developing agency for the nutrition and food wholesomeness portion of the program, and that the U.S. Army Medical Research and Development Command and its subordinate, Letterman Army Institute of Research (LAIR), will serve as the performing laboratory.

The triservice regulation, "Nutritional Standards," charges the Surgeons General with the establishment of appropriate nutritional standards for military personnel subsisted under normal and various extremes of climate and terrestrial environments. The responsibility to conduct surveys to determine the nutritional adequacy of the foods consumed and to determine the nutritional status of personnel is also indicated by that regulation.

The majority of the nutrition research is directed toward fulfilling the responsibilities outlined in these two regulations, with a small effort directed toward the nutritional needs of patients suffering from diseases or injuries common to the military. A very limited effort is directed toward defining the nutritional requirements of the working military "dog."

The major concern at LAIR in providing foods is that they be wholesome (that is, free or with a sufficiently low level of toxins, micro-organisms, foreign compounds, and products of degradation) to preclude hazards to health. A critical need exists to develop microbiological, chemical, and nutritional standards for the new foods--freeze-dried, precooked, frozen, concentrated, and other convenience items that are rapidly being introduced into the military feeding systems.

This effort is ongoing, and, during fiscal year 1977, a program was initiated to define the chemical safety of foods that may have become contaminated by various degradation products under the adverse storage conditions required by military operations. Both programs are coordinated with the Department of Agriculture and the Food and Drug Administration.

Nutrition has a major influence on the health and performance of military personnel. Providing optimum nutrition to the individual requires knowledge of interrelated factors upon his requirements, his work environment, and the food that can be supplied. Research on human requirements for individual nutrients is being accomplished to verify the magnitude of requirements previously implied by animal research. Energy requirements, particuarly for various levels of activity and under extremes in environmental conditions, are continuing to be investigated to ensure adequate ration logistics and enhanced combat effectiveness.

The knowledge of human nutrient requirements is incomplete, particularly in terms of the varied climates, physical activity, and the emotional stress imposed by military operations. LAIR therefore has an ongoing program to identify those nutrient requirements (e.g., proteins, carbohydrates, fats, vitamins, and minerals) that may be modified by the stress of military operations, and to establish a recommended level for each of these nutrients.

In some instances, LAIR has even found it necessary to establish the requirement level for adults under normal conditions. These efforts have been cited by the Food and Nutrition Board of the National Research Council in the establishment of the adult requirements for 13 nutrients, as is evidenced in the 1968 and 1974 publications of the Recommended Dietary Allowances. Nutrient requirements that have been identified and quantitated are used for the establishment of nutritional standards for operational and garrison rations.

The introduction of convenience foods, short-order feeding items, item-priced cafeteria serving systems, and other innovative feeding practices into military dining facilities has created a need to know if these changes have altered the nutritional quality of the food consumed or the nutritional status of the consumer. The only accurate assessment of the nutritional adequacy is the measurement of the actual amount of food consumed and the laboratory analysis of the food aliquots to determine the composition at the time of consumption.

Surveys have been and are being conducted in Army, Navy, Marine Corps, and Air Force dining facilities to evaluate the impact of the various food service system changes upon the nutritional adequacy of the food consumed. Increasing attention is being paid to the nutritional adequacy of foods consumed outside the dining facilities, because not all potential customers use or fully use the dining facilities.

Listed below are the surveys conducted within military establishments since 1963, the year LAIR was directed by the Surgeon General to begin doing annual fiscal year surveys. Since the joint service regulation was published in 1971, business with the other services has been brisk--at their request.

Ft. Carson, Colorado	1963
*Ft. Benning, Georgia (x 2)	1964 + 1973
Ft. Huachuca, Arizona	1966
Ft. Campbell, Kentucky	1967
Ft. Irwin, California - Mohave Desert	July 1968
Ft. McClellan, Alabama - WACs	1970
*Lowry AFB, Colorado	1971
*Ft. Lewis, Washington	1971
*Ft. Myer, Virginia	1972
*POWs held by RVN	1972
*Armed Forces of RVN	1972
*ENT AFB, Colorado	1973
*USAF Peterson Field, Colorado	1973
*Loring AFB, Maine	1974
*Naval Air Station, Alameda, California	1975
*Loring AFB, Maine	1975
*Naval Air Station, Alameda, California	1976
*US Marine Corp, 29 Palms, California	1977
*USS Saratoga - at sea	1977

LAIR has also participated in surveys or studies conducted by other organizations (with approval USAMRDC, OTSG, US Army) as listed below:

ICCND Survey, Northeast Brazil	1963
ICCND Survey, Nigeria	1965
ICCND Survey, Paraguay	1965
INCAP/OIR Survey, Guatemala	1965
INCAP/OIR Survey, Costa Rica	1966
INCAP/OIR Survey, Honduras	1966
INCAP/OIR Survey, Panama	1967
Nutr. Off., HEW Survey, Navaho Reservation	1968-69
Ten State Nutrition Study	1968-71
Univ. of Colorado/NIH, Migrant Workers	1969-70
Univ. of Wisconsin/USAF/ONR, Eskimos of Wainwright, Alaska	January 1969
British Army/ARO, Study of Troops, Malaysia	1970
AID/CDC, Sri Lanka	1975

Trained personnel, worldwide, in survey techniques

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*Special studies.

The majority of the funding for the first seven surveys listed was provided by the Department of Defense. The study of Eskimos at Ft. Wainwright, Alaska, was also strongly supported by three departments of the Department of Defense. Since LAIR became responsible for DOD activities, activities in these other population groups has declined.

Various physical and chemical factors within the food or the biological response of the consumer can influence the digestion, absorption, and utilization of specific nutrients. Hence, the nutritional status of the individual must be evaluated by appropriate clinical, biochemical, and anthropometric examinations. All LAIR accomplishments in this area cannot be covered here, but, to cite two items, LAIR has devised a field type body volume meter that can be used to determine body density and body composition, and the laboratory developed the skin fold calipers that were used for the majority of the nutrition surveys until the advent of the Lange calipers in the late 1960s.

The derived data are integrated in terms of nutrient composition, nutrient consumption, and, where possible, work performance to determine if deficiencies or excesses exist. A portion of the effort is expended to develop tests that can be performed rapidly, accurately, cheaply, and reproducibly, yet more completely reflect the adequacy of the specific nutrient in performing its function within human tissues. Basic, meticulously controlled studies of enzymatic reactions and other biochemical processes are required to provide a basis for development and evaluation of good assessment tools.

Clinical studies at LAIR are primarily aimed at determining the role that food, nutritional status, and prophylactic medication may have upon the development and prevention of diseases common to the military. Acute and chronic diarrheas contribute significantly to the incapacity of troops in combat operations. The etiology of 80 percent of diarrheas is unknown. The implication that food may be a carrier of unidentified agents is being explored. Tentative findings suggest that antimalarial drugs in some individuals produce or aggravate malabsorption of nutrients from the gastrointestinal tract. If these findings can be substantiated, the magnitude of this effect needs to be established and corrective action taken.

The means to improve the nutritional support of the injured surgical patient are of concern in order to speed recovery and to reduce hospitalization time.

In a 5-2/3 year period, 2,400,000 man-days were lost due to hospitalization of 60,000 personnel in Vietnam with bone and joint injuries. Particular emphasis is being paid to nutritional factors that may improve bone repair, wound healing, and the immune response.

In summary, the nutrition research program of the Army is aimed at ensuring the nutritional adequacy of the diet consumed by military personnel, establishing the nutrient requirements that will permit operations under all conditions of climate and environment while preventing loss of efficiency or development of diseases, and employing nutritional means to reduce the impact of disease and injury upon military personnel and military operations.

In addition to the work at LAIR, programs in the rest of the Department of Defense deserve mention. Previously there was a very vigorous nutrition program at the Quartermaster Food and Container Institute in Chicago, prior to its move to Natick, Massachusetts. Leaders of that program included Drs. Harry Spector and Doris Calloway, to name only two, but since being at Natick, the cutbacks in budgeting and personnel have reduced that level of effort. The last reorganization, a month ago, left only three people, including one technician.

The Air Force effort, which was fairly extensive and quite vigorous a decade ago, has been similarly reduced.

The Navy's program, which included a vigorous group here at Bethesda, has been eliminated, except to address specific weapon system problems.

The Institute of Surgical Research, the Army's Burn Center in San Antonio, Texas, does have a good, ongoing, vigorous program in the nutritional care of patients with burns.

U.S. DEPARTMENT OF AGRICULTURE

PROGRAM IN NUTRITION

M. Rupert Cutler, Ph.D.
Assistant Secretary for Conservation,
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U.S. Department of Agriculture

Looking ahead to the unexplored frontiers of nutrition in the 1980s, I see the U.S. Department of Agriculture developing a twofold approach. First, we will be researching the hard questions remaining in human nutrition. Second, we will be doing a better job of educating the public about nutrition.

At USDA we see eight top-priority questions for human nutrition research for the 1980s. They represent a consensus among several recent major human nutrition research studies.

The first researchable question is: What should persons eat?

Answers on major diet deficiencies have been relatively easy to obtain. We already have learned enough to control major nutritional deficiency diseases in the United States. You might say we have answered the easy questions. We have, in a sense, "skimmed off the cream" in certain branches of human nutrition research. What remains is to find the answers that are more elusive and require innovative research methods to obtain.

We need research on the nutritional requirements of persons in all stages of life. Particularly crucial are requirements for the prenatal stage, for 6- to 23-month-old infants, pre-school youngsters, adolescents, women of childbearing age, and the aged.

More information is needed on how nutrition relates to intellectual and emotional growth, pregnancy, lactation, menopause, and work.

Studies need to be conducted that will relate the level of nutrient intake to the prevention and moderation of degenerative processes. They should show us the effect of vitamin and trace element supplementation on the physical performance, health, and well-being of the elderly.

We need to identify the nutrients required for various levels of work function and performance. With such information, an individual could select a diet to fit the work needs for a day, a week, or a year--and vary that diet as the needs change. Such a diet would not only save food expenses, but also would improve performance at work and at leisure.

Research is needed on obesity, the most widespread nutritional disorder in the United States. Obesity is a primary risk factor for diabetes and cardiovascular disease. Currently, about 30 percent of middle-aged American males and 40 percent of the females are considered obese. Despite the magnitude of this problem, the fundamental causes remain obscure. The public spends large sums on diet foods and weight reduction schemes and has poor understanding of the basic mechanisms, benefits, and risks.

The second and third researchable questions are: What are people actually eating, and how does this affect their nutritional health?

American supermarkets today offer consumers the opportunity to choose from among some 11,000 different products. New products are introduced almost daily. Other products disappear from the shelves. Our food supply is a kaleidoscope of constantly changing packages, products, formulas, and convenience.

The result is that people's eating patterns are likely to be changing faster than we can monitor them with present techniques. Therefore, the first order of business is to revise the methods we use to find out what individuals eat, and find new ways to measure the nutritional impact.

Currently, the Federal Government uses two principal means of monitoring American diets. First is the National Food Consumption Survey (NFCS) conducted once every 10 years by the Department of Agriculture. The second principal method of monitoring diets and nutrition is the Health and Nutrition Examination Survey (HANES), conducted by HEW's National Center for Health Statistics, with help from the Center for Disease Control. It provides historical, laboratory, and clinical data on the health and nutritional status of a sample of 30,000 individuals.

There are serious limitations in both the methods and the timing of the surveys. A 10-year interval between USDA's Food Consumption Surveys is too long to keep up with today's rapid changes in foods and eating habits. It also means the survey does not mesh with the more current nutrition data of HANES.

So the Food and Agricultural Act of 1977 directs both our departments jointly to develop a comprehensive nutritional monitoring program. What is wanted is a national monitoring system that will cover nutritional status, nutritional quality of the food supply, dietary practices, nutrition knowledge and attitudes, and food and nutrition program effectiveness. We want a system that will in effect ring a bell when Federal nutrition intervention is warranted. The system also has to supply information that will help determine what kind of intervention is needed.

The proposed system will include monitoring of nutrients in foods and food groups. It would provide new data to USDA's Nutrient Data Bank. It also would broaden coverage of total diet studies such as the "Market Basket Survey." It would analyze meals offered as fast foods and TV dinners. Most important, it would integrate the information from USDA's National Food Consumption Survey and HEW's Health and Nutrition Examination Survey.

If the proposed integration is implemented, our survey--NFCS--would collect data every 5 years instead of 10--to make the data more timely.

The fourth question is: What factors actually shape people's eating habits?

Efforts to formulate national nutrition policies or to design intervention programs, educational programs, or possible regulatory actions need to be based on knowledge of the factors affecting consumer choices. These factors include price, income, family size and composition, advertising and packaging, labeling, wholesale and retail marketing practices, convenience of preparation, education, health status, and individual and family attitudes.

We should identify factors most readily influenced by education and information. We should focus on eating habits of such vulnerable groups as pregnant women, infants, and the elderly.

The fifth question is: What happens to our food from its origins on the farm until we eat it, and how do all the steps in between affect the safety, quality, and nutritional value of our diets?

Data are lacking on the amounts of important nutrients that occur in various foods. Much of the current information is obsolete because of changes in agricultural production, because of the introduction of new varieties and processing methods, and because of new storage and transportation facilities.

Research needs are the following: 1) investigation of the factors affecting the ability of people to utilize nutrients in specific foods, as well as factors affecting the chemical form of the nutrient, its relationship to other nutrients, and the presence of inhibitors; 2) study of the nutrient changes in foods that occur after harvest or slaughter and during processing and distribution; 3) determination of the social and economic feasibility--and nutrient possibilities--of new or improved food processes; and 4) conversion of scientific findings from public and private laboratories into readily useful information for consumers, public agencies, and private businesses and organizations.

We need to develop improved methods for food composition analysis. The methods currently available for analysis of many of the known nutrients are slow and imprecise. For some nutrients, no standard analytical methods exist.

The sixth question is: How do government intervention and nutrition education programs affect the health, nutritional status, and performance of the people they are intended for?

This is one of the most difficult questions to answer. Clearly we need to develop better methodologies for measuring the effectiveness of such programs.

We have a long way to go in designing information programs that effectively combat food and nutrition misinformation, inform the public on food safety, and encourage people to change their food habits. We need to determine which communication tools work best in getting people to modify their food choices.

Priority must be given to designing and carrying out surveys on diet practices to determine which groups in our population are most vulnerable to poor food habits. More work should be done to evaluate alternative food intervention programs to find better ways to test evaluations of food fortification.

The seventh question is: What are the nutritional effects of agricultural and other U.S. government policies and regulatory programs?

Currently, there are no studies underway to find the impact of various government policies on the nutritional health of our people. This is an area we must address if we are to arrive at a coherent, comprehensive nutrition policy. It means we must look not just at the government policies directly related to food production and distribution, but also at many others that relate indirectly to nutrition but nonetheless have a profound effect on eating patterns.

More specifically, we need research on the nutritional effects of government activities in establishing and enforcing food grades and standards; packaging, labeling, and advertising requirements; and other measures to regulate marketing practices. We need to know the nutritional impact of government crop adjustment programs, of our international trade policies, and grain reserves.

How is human nutrition affected by food production strategies, agricultural research and cooperative extension programs, and rural credit services? Beyond those programs directly related to food, we need to look at the effects on nutrition of welfare and other income subsidies, income taxes, manpower policies, health, environmental health, and other general government policies. We must be particularly concerned about the effects of government policies on those most vulnerable to malnutrition--the poor, the young, and the elderly.

The eighth question is: What are the special considerations we must take into account in helping to meet the dietary needs of people in other countries?

From 500 million to 1 billion people in this world suffer from extreme malnutrition and hunger. The President's commitment to aid these people makes human nutrition research vitally important. Our research should assist all countries, but especially those whose people face extreme hardship. Therefore, the design of our studies must take into account a range of circumstances that may differ widely from our own.

This is an imposing set of priority questions. We at USDA are taking steps to find the answers. We are beginning by giving human nutrition research major emphasis. This year we will spend from $24 to $25 million on human nutrition research. In addition, the universities cooperating with us, as well as other cooperators, probably will spend one-half that amount, resulting in a total of $37 million in this fiscal year for human nutrition research.

We have a new Competitive Grants Research program that includes $5 million for human nutrition research in FY 1978. The program is open to all researchers--public and private, government and university.

Within USDA, the chief unit for human nutrition research is our Human Nutrition Center, recently formed as part of our new Science and Education Administration (SEA). It conducts research at eight laboratories in human requirements for nutrients, food composition and improvement, and food consumption and use.

Also under the new SEA are: 1) Cooperative Research, which funds research at state land grant universities, encompassing nutrition requirements, diet surveys, relation of diet to disease, food composition, and many other areas; and 2) Extension, which supports nutrition education programs across the country through the state and county cooperative extension system.

Beyond SEA, USDA's Economics, Statistics, and Cooperatives Service does research on consumer choices, food consumption, and domestic food programs. And its Food and Nutrition Service supports studies on food program effectiveness.

This rather brief survey of USDA research is far from exhaustive, but it presents a general idea of some of the steps we are taking now to find answers to the eight priority questions.

One thing I do want to stress: There is a new wind blowing in human nutrition research and education at the U.S. Department of Agriculture. Nutrition research and nutrition education are no longer taking a back seat at USDA. What Secretary Bergland told a Senate committee last September set the tone. He said: "When I entered the Department of Agriculture 8 months ago, I discovered that issues such as meal quality had been largely ignored by policymakers in past administrations. I am determined that such issues be ignored no longer."

Like research, nutrition education is going to get a great deal of additional emphasis at USDA. It is a particularly crucial area. Americans are more aware--and more concerned--about eating and health than they have ever been before. But Americans are not only concerned. They are also confused. They are deluged by information, much of it contradictory. They are told America is the best-fed nation on the earth. But then they are told they are eating too much--that fat kills. They are told bacon contains nitrates that may cause cancer and that the hamburger contains carcinogens. The daily menu begins to read like a prescription for slow death.

Yet as all this information comes at them--from the popular media, from scientists, from doctors, from government--they are told that a great deal is not really known for certain about nutrition and health. The result is that the public becomes confused. It also becomes skeptical. This is why nutrition education is crucial. This is why we have to fashion a nutrition education program that Americans have confidence in.

Americans want a source of sound dietary guidance. They want to know more than what not to eat. They want to know what they should eat. They want to know what part fat, cholesterol, sugar, salt, and fiber play in nutrition. They want to know about foods that are safe. And they want food labeling that is useful. They want a reliable source of information, in a form that is understandable and applicable to their daily living. They want reliable information that will help them make sense out of the contradictory and confusing messages about nutrition in the popular media.

Americans are especially concerned about such things as food advertising and marketing practices, particularly those aimed at children. I am sure most of you here have children or grandchildren. I hope they were not among the children who watched weekend daytime TV in the first 9 months of 1975, because Robert Choate, president of the Council on Children, Media and Merchandising, called TV at that time "edible TV." I call it an affront to nutrition education.

According to Mr. Choate, a child watching weekend daytime TV in the first 9 months of 1975 could have seen 3,832 commercials for cereals--many of them the heavily sugared kind. This child could have also seen 1,627 other TV commercials for candy and chewing gum. By contrast this same child would have seen only two commercials for meat and poultry--and one each for vegetables and cheese. Mr. Choate adds that a child watching TV "moderately"--that is, 26 hours a week--was bombarded with 8,500 to 13,000 food and beverage commercials during the year.

Now where does that leave nutrition education? Facing some pretty stiff competition, I would say. It leaves us who are concerned about providing sound nutrition education with a big job. That is why we at USDA are giving high priority to fashioning nutrition education programs that the public can have confidence in and readily apply to daily living. In FY 1978, the USDA will spend over $108 million on nutrition education.

Even though there is a great deal we do not know about nutrition and health, there still is a great deal we do know. And we must get what we do know across to the public through education. By this I mean that the information has to be presented in a way that will enable the individual to apply it to his particular needs and problems. Above all, the information has to be practical information the individual can use--and will use.

And by "education," I mean imparting fundamental knowledge about nutrition. Once the individual knows how the nutritional processes work in the body, he can evaluate his own diet with a minimum of myth and misunderstanding.

Our approach at USDA in nutrition education is threefold. First, our Extension and food assistance programs plan to reach low-income consumers directly. Second, TV and other media will be used to reach a broader public. And third, the food industry and food growers will be reached through educational materials on food composition and nutrient needs. They also will be reached through regulatory programs. That is our general approach.

Here are some specifics: In our FY 1979 budget, we have requested funding for a mass-media pilot information program. It will use TV and other mass media to disseminate nutrition messages. It will coordinate nutrition education with our Food Stamp Program, with our child-nutrition "school lunch" program, and with our women, infants, and children program (WIC). It will get nutrition education into the supermarkets. It will work with senior citizen organizations, employee health programs, unions, health professionals, consumer groups, and community groups serving low-income people.

Above all, this pilot project will take a coordinated approach--one that makes sure the messages and nutrition activities reinforce each other. It will also develop methods to evaluate the effectiveness of nutrition information and education efforts. It will determine what media techniques and messages, and education activities, singly or in combination, work the best. It will compare the effectiveness of paid media messages with those of public service announcements.

The pilot project will be set up in four urban and suburban Midwest communities.

Let me say a few words about Extension. Its nutrition education program--the Expanded Food and Nutrition Education Program (EFNEP)--is the major nutrition education program in the Federal Government.

EFNEP employs paraprofessionals trained and supervised by professional nutritionists. These paraprofessionals teach low-income families improved dietary practices. At present, there are 6,500 such nutrition paraprofessionals in EFNEP. They are employed in approximately one-half of U.S. counties. Since its inception in 1968, EFNEP has reached 1.4 million low-income families--a total of 6 million individuals.

Although EFNEP is Extension's major effort in nutrition, Extension has other programs that reach people at all income levels--not just those at low-income levels. Last year, 4,000 Extension home economists spent 40 percent of their time serving individuals and families at all income levels. Extension's 4-H youths conducted over 692,000 food and nutrition education projects for the public at large. Extension used radio and TV, newspaper articles, pamphlets, and conferences in an effort to reach all segments of the public. It trained elementary teachers, school food personnel, and other professionals.

Our National Agricultural Library's Food and Nutritional Information Center plays an important role. It plans to expand its activities so that it will serve individuals and institutions--like public schools--as well as agricultural specialists. Child Nutrition Program personnel currently make up the largest potential users of its services. Other groups of users are community nutritionists, consultant dietitians, university and college professors, librarians, public health nutritionists, extension agents, and nutrition education specialists. The Center publishes the "Catalog of Food and Nutrition Information and Educational Materials."

But we in government cannot carry out the nutrition education effort alone. The food industry could help more. For example, it could draw up an advertising code of ethics of children's advertising. I understand that some advertisers have considered this. I encourage them to follow through.

Parents and teachers could help more. They have to meet us half way. It's the old story about leading a horse to water. We can provide the nutrition education materials. But only they can use and apply them.

So as I look ahead to the 1980s, I see a greater cooperative effort in human nutrition research and education. I see us overcoming public confusion over contradictory information about nutrition and health. I see Americans better informed about nutrition and health--and living healthier, happier, and more productive lives. I see better living through better nutrition.

PANEL I: GENETIC DISORDERS: LESSONS FOR CLINICAL NUTRITION

Panel leader: Kurt Isselbacher, M.D.
Mallinckrodt Professor of Medicine
Gastrointestinal Unit
Massachusetts General Hospital

Panelists: Joseph L. Goldstein, M.D.
Chairman, Department of Molecular Genetics
The University of Texas Health Center at Dallas

Charles R. Scriver, M.D., F.R.S.C.
Professor of Pediatrics and Professor of Biology, McGill University, and Director of deBelle Laboratory for Biochemical Genetics
Montreal Children's Hospital

Biochemical genetics has advanced our understanding of the interactions between genes and nutrients, development and treatment of certain diseases, in the understanding of normal development and in the prevention of disease. Thus, the nature-nurture concept can be put forward as follows: health is a state of equilibrium between the extrinsic environment (in this case, nutritional modalities) and our intrinsic genetic make-up.

The balance between nature and nurture resides in the genetic nature of our cells and the gene products controlled thereby. We have learned, initially from the studies of Harris at London University's Galton Laboratories and extended since by many other investigators, that the human genome is characterized by polymorphism, implying that everybody represents a population of genetic diversity and that each of us differs from others (at least 6% of our gene loci). Thus, if we examine amino acid levels in blood plasma, we find that under identical nutritional conditions two different individuals will have a fasting blood amino acid profile that is quite different, while monozygotic twins will have a fasting blood amino acid profile that is similar. The similarities between the monozygotic twins and the differences between the non-twin individudals merely illustrates very powerfully the role of intrinsic factors in the "milieu interieur" described by Claude Bernard over a century ago.

Therefore, one might consider that health and disease today is reflected in a spectrum of origins. Dr. Scriver indicated at one end such a spectrum would include the extrinsic causes of disease. Pellagra is a classic example of an extrinsically originating disease. At the opposite end of the spectrum are illnesses where the major origin is intrinsic, such as genetic causes of illness. In the middle of the spectrum are the multifactorial diseases in which specific extrinsic and specific intrinsic origins come to interact to produce disease.

Goldberger referred to pellagra as a nutritional illness, and we could view this as an extrinsic illness. But, as knowledge has increased and as we have been able to remove the extrinsic causes of pellagra, we will discover that there is pellagra with high heritability because it has an intrinsic origin. Kwashiorkor resulting from protein malnutrition is an extrinsic illness because we cannot synthesize essential amino acids and we require these from our diets. Dr. Scriver, in reviewing the research and the lessons learned from studies on Hartnup disease, pointed out that from the studies of this relatively rare disease it has been demonstrated that a major component of our dietary proteins are digested and then absorbed as oligopeptides and small protein fragments, and not exclusively as free amino acids. This was a major contribution to knowledge about 10 years ago. It has also been discovered that there are transport sites on the surface of cells that are essential for uptake of amino acids not only from the intestine across epithelium but into cells in the body. This development, which is about 20 years old, is also an important component of our understanding of nutrition. Third, it was discovered that gene products are arranged differently in the various membranes of the intestinal cell, and the mutant gene product in Hartnup disease is declared in the surface of the intestinal cell membrane, but not inside the cell. In other words, we are marvelous in our heterogeneity, and we dispose our gene products in different ways and in different membranes to play various important functions.

Phenylketonuria used to be a classic genetic disease or inborn error of metabolism. It has largely disappeared from North America and the developed countries of the world because of the application of nutrition research and genetic screening. It was not possible to apply genetic screening to a newborn population until nutrition research had applied a therapeutic approach to make it worthwhile to do the screening. Dr. Scriver also reviewed the research that led to the understanding of the mechanisms in the disease known as maple syrup urine disease, which was described by scientists in London and New York about 20 years ago. It is a disease due to an inborn error of an enzyme (a branched chain keto-acid decarboxylase), which normally acts on three branched chain amino acids. By studying very carefully a cohort of patients with maple syrup urine disease in Canada, Dr. Scriver has been able to define for the first time the precise requirement of leucine for human protein synthesis during infancy and growth. It is not possible to study this process in normal individuals in quite the same way, because normally the amino acid building blocks are used as fuels, as well as for the synthesis of proteins. In individuals with maple syrup urine disease, the utilization of branch chain amino acids is impaired (genetic defect), and therefore one can titrate the amino acid requirements. It has thus been shown that the leucine requirements are somewhere between 250-600 mg/day. This is an excellent example of how one can use a rare inborn error of metabolism to define human requirements for protein synthesis and, for the first time, the need for a particular amino acid.

The therapeutic implications of such research are that there should be dietary products which will allow patients to consume their essential nutrients in a modified way. The growth and development of patients with phenylketonuria and with maple syrup urine disease have now been achieved by a variety of semisynthetic dietary food products. Knowledge from the rare diseases and from the patients with these diseases has provided information of benefit to all.

Dr. Isselbacher reviewed the research that led to the elucidation of galactosemia and to the deficiency of the enzyme, lactase. In the case of galactosemia--a genetic disorder--the problem is not in the handling of lactose per se, but in the handling of galactose that is hydrolyzed from it in the intestine. Thus, the problem arises in children or infants with this disorder who, when they ingest milk (which contains lactose), cannot effectively utilize the galactose normally liberated from it.

The galactose is absorbed from the intestine but cannot be converted to glucose in order to utilize it for energy. These studies were described at the NIH (in its Clinical Center) over 20 years ago. In this disease, when galactose cannot be converted to glucose, metabolites accumulate in the tissues, which can lead to and be involved in the production of cataracts, mental retardation, and cirrhosis; i.e., scarring of the liver. Fortunately, if the derangements are detected early and if the offending agents, milk or galactose, are eliminated from the diet immediately after birth, one can avoid many of these sequelae. The treatment is simple--namely, a milk-free diet. When this is done, one can prevent cataracts, mental retardation, and cirrhosis.

Because of the research on galactosemia, we learned a great deal about normal infant nutrition and the role of galactose in brain development. Nutritionists 20 years ago argued against eliminating milk from the diet of the infant since they considered galactose essential for brain development. However, through careful research and follow-up studies in infants with galactosemia, we now know that this is not the case; in other words, milk is not essential for normal brain development. Furthermore, this disease spawned one of the early attempts to develop alternate synthetic but nutritional diets in which the offending sugars were eliminated.

In reviewing our knowledge of the problem of lactase deficiency, it was emphasized that this is an important problem because it is so common in the adult population and because milk is a major component of most diets. Lactase deficiency or lactose intolerance is not a milk allergy but, rather, it is a disorder in which there is a deficiency in the enzyme lactase needed to break down or digest lactose. Lactose is normally digested or hydrolyzed in the intestine at the intestinal cell surface into its two component sugars. When this does not occur, we essentially wind up ingesting a laxative because lactose in that form causes fluid to shift into the intestine and to produce diarrhea. Lactose is an excellent substrate or nutrient for bacteria and, as a result, the bacteria utilize the unabsorbed lactose to produce acid and hydrogen gas. This increase in hydrogen production can be detected in the breath and be measured as breath hydrogen to detect unmetabolized nutrients in the intestinal tract. This very simple technique then allows the screening of large populations and also detects indirectly those nutrients that are not effectively absorbed by the intestine.

While the congenital form of lactase deficiency is relatively rare, the adult type, which also has a genetic component, is not uncommon. In fact, the incidence of lactase deficiency in the adult population is very common in black and oriental adults, with an incidence of up to 85%. This clearly has implications in the management of nutritional problems, especially malnutrition, in such ethnic groups, and it has been recognized that those who might need milk the most are also the most likely not to be able to tolerate it because of their underlying enzyme deficiency (i.e., lactase deficiency). One of the important considerations that affects us in reviewing the population at large is the normal change in the ability to metabolize lactose as we grow older. First of all, premature newborns are lactase deficient, and thus their ability to handle milk is decreased. After the first year of life, there is a gradual decrease of lactase activity, and by about 10-12 years of age 50% of the lactase activity is lost in the white population. As mentioned previously, this loss is even greater in blacks and orientals.

Dr. Isselbacher emphasized that, although we are concerned about normal nutrient intake in terms of carbohydrate, protein, and lipid, what may be good for one individual may not be good for another. We are all genetically different. There is genetic diversity in nutritional abilities to handle substances. There may be requirements, but a given person's requirements and his other ability to handle a certain nutrient may be different from those of others. Thus, it is important to keep in mind that, when we speak of dietary goals and nutritional requirements, we also need to focus on the ability of an individual to handle certain nutrients.

Dr. Goldstein described his studies on lipid metabolism and cholesterol metabolism, thus focusing in an excellent way on the principle of genetic diversity and the role of lipids and cholesterol metabolism in atherosclerosis. In reviewing the research in familial hypercholesterolemia (FH)--a disorder that causes heart attacks at an early age--he presented in the context of how FH fits with the general problem of heart disease and nutrition. Dr. Goldstein reviewed the list of commonly accepted risk factors for heart attacks, pointing to the main ones such as high blood pressure, diabetes, obesity, and smoking. Dr. Goldstein indicated that, although we do not yet know the detailed mechanisms by which each of these risk factors leads to heart attacks, the end result in a patient is remarkably similar; namely, the deposition of cholesterol within the coronary artery even though the blood lipid may be statistically at a normal level. Dr. Goldstein subsequently reviewed the work he had carried out in Seattle. The study involved 1,200 patients who had a previous heart attack. Only 30% of them had statistically elevated blood lipid levels. The rest (70%) had what we consider normal blood lipid levels. In this population of heart attack victims with abnormal blood lipids, 5% have a disorder called familial hypercholesterolemia. Even though it represents only a relatively small group, FH has a universal tendency to predispose heart attacks and is independent of dietary intake of fat. No matter what the diet, the cholesterol is elevated. This represents the best example of genetic diversity and the futility of recommending a universal diet for the whole population.

The studies on FH have given us insight into how the blood cholesterol level is regulated and may provide clues as to how we deal with the remaining 95 percent of patients who have elevated blood cholesterol levels and get heart attacks. FH is a genetic disorder caused by a single gene mutation that raises the serum cholesterol and causes atherosclerosis. It is inherited as an autosomal dominant trait. Individuals who are heterozygotes carry one abnormal dose of the gene, and they are in the population at a frequency of one in 500. FH is probably the most commonly inherited disorder in man. We usually think of sickle cell anemia or cystic fibrosis or Tay-Sachs disease as being common diseases, but those three diseases occur at frequencies of about one in 2,000 in certain groups. FH occurs in whites as well as blacks. Every ethnic population in the world has basically the same frequency; namely, one in 500. When a child inherits the abnormal gene from both parents, he or she has two doses of the abnormal gene which leads to a very severe state called the homozygous FH. A child with homozygous FH has enormously elevated blood cholesterol levels (about 1,000 mg %), and the cholesterol is deposited in the skin and the arteries. Children with homozygous FH have heart attacks early in life--as early as 6 years of age. Cholesterol in the plasma is carried by a lipoprotein called low density lipoprotein (LDL), which accumulates abnormally in patients who have FH. The cholesterol is carried as an oil droplet in the center of this lipoprotein.

The studies by Drs. Michael Brown and Joseph Goldstein have permitted us to understand, at the molecular level, why LDL accumulates in the arteries, skin, and other tissues of patients with FH. LDL is basically made in the liver, and its function is to take the cholesterol that comes to the liver from the diet and transport it to nonhepatic tissues, such as muscle, adrenal gland, and brain. In other words, the liver assimilates the cholesterol that comes in the diet, makes the LDL, and the LDL then acts to deliver cholesterol to the body cells. Cells need the cholesterol for two reasons: first, to form all their membranes and, second, as a precursor to make special hormones, such as estrogen, testerone, and adrenal hormones.

As LDL carries cholesterol from the liver to the body cells, it interacts with the cells via a receptor molecule on the cell surface. In the course of interacting with the receptor, the cell takes up the LDL into lysosomes, which break it down. In the course of breaking it down, the cholesterol is liberated and can be used for its membranes; this also serves to regulate the synthesis of cholesterol in the cell. In normal persons, therefore, the receptor prevents the entry of LDL (with its cholesterol) into the cell resulting in a lowering of plasma level of LDL and providing the cell with the cholesterol that it needs. Patients with homozygous FH completely lack the necessary receptors and are therefore unable to take up LDL. Since the cells cannot take up LDL and its cholesterol, they turn on their cholesterol synthesizing machinery and make their own cholesterol in order to survive. The end result is that the LDL accumulates to very high levels, and its cholesterol is deposited in the arteries and in the skin.

Persons with the heterozygous form of FH have basically half the number of receptors (those people who are found in 1 in 500 in the general population have heart attacks at age 30 to 50 and premature atherosclerosis). In an attempt to correct this defect, the LDL level is increased, resulting in a blood cholesterol level of about two times normal. These hererozygotes have cholesterol levels of around 400 mg %. Thus, a normal person would have an average blood cholesterol level of 200; a heterozygote, 400; and a homozygote, 800-1,000 mg %. Subsequently, Dr. Goldstein emphasized, in a most dramatic way, that FH is independent of diet by describing a Belgian family who already had a child with homozygous FH and wanted a prenatal diagnosis at a subsequent pregnancy. At 20 weeks of pregnancy, the fetus had a blood cholesterol level of 279 mg % (which is 9 times the normal level) indicating that this disease was manifesting itself at this early stage in utero. In fact, cholesterol was found to be deposited in every tissue in the body of the fetus. It is evident that patients with FH have a high blood and tissue cholesterol level independent from diet and have heart attacks at a young age independent of other risk factors. This disease tells us in a very important way that the cholesterol level in the blood appears to be important in the pathogenesis of coronary arteriosclerosis and heart attacks.

As mentioned earlier, we do not know much about the disease mechanism involved in the patients who have heart attacks and elevated blood lipids (30%), and we know even less about the mechanisms involved in patients who have heart attacks and normal lipids (70%). The important point is that we know something about the mechanisms involved in the 5% of patients with FH who get heart attacks early in life. It is clear that these individuals are unique and that diet will not cure their disease. The cure of their disease will come from a pharmacological intervention that will lower their plasma cholesterol level. It is clear, therefore, that everyone is genetically different, and the chances are likely that everyone is not going to respond the same way to the same diet. We all know individuals who eat seven or eight eggs a day and who never have problems with heart disease or an increased plasma cholesterol level, while other individuals eating only one or two eggs a day will have a significant increase in their blood cholesterol. Present research findings support the concept that many different genes are involved in the response to different environmental factors, including diet, and one probably is going to have to work out the mechanisms for these different subgroups before one can really prescribe a diet that would basically be appropriate for everyone.

PANEL II: NUTRITION IN PREGNANCY AND EARLY LIFE: LONG-RANGE DIVIDENDS FOR BRIEF, ENLIGHTENED EFFORTS

Panel leader:	Norbert Freinkel, M.D. Kettering Professor of Medicine Professor of Biochemistry Director, Center for Endocrinology, Metabolism, and Nutrition Northwestern University Medical School
Panelists:	John F. Wilber, M.D. Professor of Medicine Department of Medicine Center for Endocrinology, Metabolism, and Nutrition Northwestern University Medical School
	Jules Hirsch, M.D. Professor and Senior Physician Rockefeller University

Pregnancy modifies the disposition of every nutrient in the mother. Recent studies have delineated the metabolic profile of normal pregnancy and are forming the basis for rational nutritional approaches. However, implications extend far beyond maternal welfare. During pregnancy, the fetus develops from a fertilized egg into a multi-cellular, multi-functional, and multi-potential structure. The building blocks are derived entirely from the mother and are ultimately determined by what she eats, how she handles these nutrients, and how they are stored and recalled. Thus, pregnancy constitutes a unique form of tissue culture experience, and nutritional manipulations of the mother may provide an extraordinary opportunity for influencing fetal development.

In any analysis of the potential impact of maternal nutrition upon the fetus, distinction must be made between two types of developing fetal cells. Many of these cells undergo continuous renewal throughout the lifetime of the offspring (e.g., skin, intestinal tract, liver, kidney, hematopoietic components, etc.) so that their long-range characteristics need not be greatly affected by intrauterine nutrition. Contrariwise, other developing fetal cells, such as brain cells, fat cells, muscle cells, and perhaps certain endocrine cells, have limited replicative capacity. For such cells, intrauterine events are of paramount importance. The panel attempted to demonstrate that much of the total endowment and function of these cells in the offspring may be determined by nutritional opportunities during intrauterine and perinatal life.

Toward the latter objective, Dr. Freinkel initially reviewed the changes in metabolism that occur in the mother as a consequence of pregnancy per se and the key role that maternal insulin plays as the ultimate arbiter of the metabolic mixture that gains access from the mother to the fetus. The fat cell was presented as a cell with relatively limited replicative capacity, and Dr. Hirsch reviewed perinatal metabolism and other factors that delimit fat cell development. Dr. Wilber focused on the central nervous system as a structure with even less replicative potential and reviewed studies pointing to long-range neuroendocrine alterations as a consequence of changes in nerve cell development due to perinatal nutritional deprivation.

Dr. Freinkel emphasized that the metabolism of every maternal nutrient is altered during late gestation. His group has described certain properties that characterize the fed state and certain other features that represent distinct modifications of the fasted state. With regard to the fed state, the ingestion of glucose elicits a greater rise in blood sugar and a more prolonged hyperglycemia in normal late pregnancy than under nongravid conditions. Since transplacental flux of glucose is directly proportional to levels of circulating glucose, this "facilitates" greater access of the ingested glucose to the fetus. In normal late pregnancy, oral glucose also depresses glucagon more profoundly than under nongravid so that preservation of hepatic glycogen is "facilitated." These, and other features, have prompted the suggestion that the fed state in late pregnancy is geared for "facilitated anabolism." However, the prevailing insulin resistance necessitates a far greater outpouring of maternal insulin in response to feeding so that the "facilitated anabolism" during the fed state entails a considerably increased insulin overhead. When food is withheld from the mother in late pregnancy, mobilization of fat, ketogenesis, and diversion to the oxidation of fat occur much more rapidly than under nongravid conditions. The heightened propensity to lipolysis and ketogenesis in the fasted state in gestation has been designated as "accelerated starvation"; it serves to "spare" maternal glucose and amino acids for continuing abstraction by the fetus.

In normal, nonpregnant conditions, metabolism undergoes minor oscillations between net anabolism and net catabolism with meals (i.e., in the fed state) and between meals (i.e., in the fasted state) respectively. The hormone chiefly responsible for doing this in an effective and integrated fashion is insulin. During pregnancy there are greater challenges to metabolic reserves because of the enhanced oscillations resulting from "facilitated anabolism" and "accelerated starvation."

All this, however, assumes major importance only because of the implications of these oscillations for the fetus. Within the constraints of placental blood flow and placenta permeability, the nutrient mixture in which all the new fetal cells are developing is totally dependent on what is happening on the maternal side of the placenta. We know that glucose diffuses readily by facilitated diffusion and gains access to the fetus. Amino acids are pumped upstream and are actively transported. The status of free fatty acids varies in different species, but in humans it is probably very limited in terms of net flux. Ketones traverse readily across the placenta and thus gain ready access to the fetus. Insulin does not cross the placenta. Since insulin is ultimately involved in every aspect of maternal fuel econony, the final determinant of what constitutes the nutrient mixture supplied to the developing fetus is that overall state of maternal insulinization. This is why the study of diabetes in pregnancy is a unique biological model--since it is one where the nutrients or fuels are least restrained.

To underscore the exquisitely sensitive role of maternal insulin, Dr. Freinkel reviewed ongoing studies in patients with gestational diabetes. Herein a transitory appearance of diabetes becomes manifest in late pregnancy. It is usually so mild that no intervention with exogenous insulin is instituted. And yet the slight diminution in maternal insulin leads to underutilization of all ingested nutrients so that minimal but significant increases can be demonstrated during late pregnancy not only in maternal plasma glucose but also in the circulating levels of maternal free fatty acids, triglycerides, and certain amino acids. More importantly, these modest increments in the plasma levels of maternal fuels during the last 6 to 8 weeks of pregnancy can be correlated with increases in the birth weight of the offspring at delivery. The ongoing prospective studies would indicate that an increased mixture of all types of nutrients has been available to the fetus and that this plethora of mixed nutrients has provided the fetus with increased substrate as well as increased stimulation for insulin secretion with consequent increase in birth weight, with more muscle cells, fat cells, adipose stores, and increased glycogen.

The macrosomia reflects an integrated effect upon multiple cell types. But what about individual structures? One distinguishes two types of cell development during intrauterine life. Most cells--such as those of the gut, liver, kidney, skin, and most endocrine glands--just keep turning over and over throughout life, thus undergoing constant replacement. This is not, of course, the case with all cells. There are certain cells that have a finite period of development, during which time they are formed as terminal structures, and one in essence acquires one's entire lifetime endowment. Presumably, beta cells in the pancreas, fat cells, muscle cells, and brain cells are such terminal cells. The best data suggest that one has at most perhaps a two-or-three-time capacity for replicating beta cells throughout a lifetime. Adipose or fat cells are perhaps one-third formed during intrauterine life, during the first few months of life more are formed, then there is a period of quiescence, then there is a transitory period of formation again during adolescence, and the potentiality for a very limited additional increment during adult life. For muscle cells, there appears to be a finite development in utero, some additional development during the first few months of life, during adolescence, and from then on there is no further myogenesis. Data are most secure with regard to brain cells. In man, about two-thirds of the brain cells are formed during intrauterine life, and the rest during the first year of life. Beyond the first year there is no further brain cell development. Thus, quite clearly, intrauterine developmental opportunities may have major implications for the function of these terminal cells throughout life.

Dr. Hirsch continued the discussion, presenting in detail the development of the fat cell. Studies in the understanding of fat cell development are essential to the understanding, prevention, and control of obesity--our number one public health problem.

Studies based on biopsy of human adipose tissue indicate that the fat cells are incredibly active in a metabolic sense. Fat cells have a very close relationship in terms of their size to insulin levels. In fact it is the insulin level that tracks adipocyte size rather that the reverse. It is also clear that early nutritional experiences interdigitate with genetic factors, and the combination of the two has a very strong influence on the determination of the ultimate cell number. Once cells appear in adipose tissue we have no evidence that they dedifferentiate all the way toward disappearance. As a consequence of this, nutritional factors that make for the appearance of more cells at any stage of life, but more particularly early in life, do have a lifelong consequence as to the total amount of fat stored and therefore obesity. In a study of identical twins, the twin who was more obese that the other also had a higher birth weight and a more rapid gain in weight early in life. Although these twins were identical, they had a marked and persistent difference in cell number. This study shows conclusively that in man the establishment of cell number is a postgenetic phenomenon. This could have occurred partly in utero, partly in early life, but most obviously is not genetically determined.

Studies in animals, particularly rodents, indicate that the ultimate amount of fat storage is highly determined by early feeding experiences. It is perfectly clear that the undernourishing or overnourishing of rodents early in life makes for permanent differences. What meaning do these findings have in terms of human obesity? There are many lines of investigation at the present time that are strongly suggestive that early nutritional experiences are of extraordinary importance in the incidence of obesity. Of course there are other investigations that show that obesity occurs for other reasons, and early nutritional experiences are not the only explanations or reasons for the occurrence of obesity as seen today in the American adult population.

In terms of critical periods in the development of obesity, studies on the Dutch famine that occurred in the western cities of the Netherlands in the winter of 1944-45 show that infants who were deprived of calories during the first several months of life had the least incidence of obesity in later years, whereas those who were deprived of calories during intrauterine life or later did not have a diminished incidence of obesity as though the first few months of life were indeed critical as important determinants of obesity later in life.

Additional studies by Swedish investigators on the treatment of obese adults indicate that the treatment of obesity is more apt to be successful and permanent in terms of weight reduction in those adults who did not have an increased number of fat cells and whose cells were merely engorged in size. It is clear that the determinants for cell number are nutritional factors early in life and can have extraordinarily profound consequences for whether obesity will occur later in life, if so what its severity will be, and finally whether it will be treatable by currently available means.

Brain cells are also terminal cells. Thus, nutritional influences during brain cell development can have a profound influence with regard to brain cell number, function, and integrative activity in later life. The brain plays a major role in the regulation of the endocrine system. This provides a mechanism through which undernutrition during brain cell development can have grave implications for long-range well-being, growth, cellular metabolism, and even reproductive capacity.

Dr. Wilber addressed the question of whether nutritional deprivation during intrauterine or early postnatal life might alter nerve cell development and produce significant long-range neuroendocrine changes. Dr. Wilber described studies in newborn rodents that were carried out during the time period of maximal brain growth; i.e., between birth and 16 days of age. This time period was chosen because it is the developmental stage, in the rodent, that corresponds to the time period of maximal brain growth in the human, which is the first 6 months of life.

The two hormones studied were growth hormone that regulates somatic growth, and thyrotropin, which regulates hormonal secretions from the thyroid gland. Both hormones are controlled by specialized nerve cells in the hypothalamus that are termed releasing hormone neurons, because they elaborate small substances into the portal vessels to be delivered to the pituitary gland cells. The studies were performed in newborn rats. Nutritional deprivation was achieved simply by permitting the newborn pups to nurse for only 8 hours during 24-hour periods, instead of the normal pattern of ad libidum suckling. Measurements of blood and tissue hormones were performed by radioimmunoassay.

Measurements of pituitary weights and growth hormone determinations indicate that the malnourished pups underwent marked pituitary loss with which there was associated a three-fold reduction in the pituitary mass of growth hormone. This deficiency of growth hormone was accompanied by dramatic changes in bodily growth. The results indicate that neonatal malnutrition has a profound impact on growth hormone secretion and somatic growth. The growth stunting was reversible by the administration of growth hormone.

A substantial fall in thyroxine concentration occurred after 16 days of intermittent feeding. This decrease in thyroid hormone affects the entire organism including the developing brain. But what is the mechanism of this observed thyroid deficiency state? Such a hypothyroid state could result from an abnormality in: 1) the thyroid gland itself, 2) the pituitary production of thyroid stimulating hormone (TSH), or 3) the production and secretion of thyrotropin releasing hormone (TRH) at the level of the brain. Further studies on the neuroendocrine regulation of the thyroid gland were performed in order to define the level at which nutritional deprivation decreases the function of the thyroid gland.

Further studies, in which specimens of the pituitary gland were incubated with progressive quantities of synthetic TRH, indicate that starvation did not exert adverse influences on the pituitary gland since the incremental responses seen were identical to those of normal specimens. Thus, the experiment gave the pituitary as well as the thyroid gland a clean bill of health and suggested that dysfunction had occurred at the neuroendocrine portion of the brain.

Dr. Freinkel summarized by stating that maternal undernutrition could affect fetal brain cell development by limiting the availability of critical building blocks, such as amino acids, or by introducing an alternative oxidative fuel; i.e., ketones. The precise metabolic implications of the availability of ketones during periods of brain cell development remain to be elucidated. However, some suggestive evidence has accrued that they may exert some direct effects above and beyond actions ascribable to protein deprivation. For example, in epidemiological studies with human subjects it has been noted that acetonuria during pregnancy of diabetic subjects was associated with lower scores of mental and motor tests at 8 months, neurological posture at 1 year, and Binet IQ at 4 years in their offspring. In another study not involving diabetic subjects but in whom acetonuria occurred for other reasons, similar findings were obtained.

Dr. Freinkel concluded by emphasizing that the panel attempted to address the fact that permanent cell changes can occur due to nutritional factors operative during the period when nonreplicating cells are most conditioned by the exogenous environment. The panel also advanced the thesis that there is a finite period in which there is an extraordinary opportunity for biochemical engineering. The operant question would be whether nurture can modify nature via the regulation of intrauterine environment. There is mounting evidence that this is indeed the case. Pregnancy and the perinatal period present a unique opportunity to achieve major yields and long-range "pay-off" in return for relatively short-lived and minor manipulations.

PANEL III: BASIC BIOCHEMICAL RESEARCH: A KEY TO THE SOLUTION OF NUTRITIONAL DISORDERS

Panel leader: Gilbert A. Leveille, Ph.D.
Chairman, Department of Food Science and Human Nutrition
Michigan State University

Panelists: Hector F. DeLuca, Ph.D.
Chairman, Department of Biochemistry
University of Wisconsin

Dale R. Romsos, Ph.D.
Associate Professor
Department of Food Science and Human Nutrition
Michigan State University

Harry P. Broquist, Ph.D.
Head, Division of Nutrition
Vanderbilt University

Edward D. Harris, Ph.D.
Assistant Professor of Biochemistry and Biophysics
Texas A&M University

This panel was structured to illustrate the importance of basic biochemical research to an understanding of significant problems in nutrition. One example was selected to demonstrate the significant contribution this type of research has made to our understanding of nutrition and to the treatment of nutritional disorders. Three additional examples represented fundamental biochemical research with the potential of making extremely significant contributions to nutrition-related health problems.

Dr. DeLuca discussed his classic research on vitamin D metabolism. It was pointed out that rickets was nearly epidemic in the United States until the discovery of vitamin D. Fortification of milk with the newly discovered vitamin virtually eradicated this disease. It was recognized that a lack of vitamin D results in a defect in the mineralization of bone and that this defect could be corrected by the administration of vitamin D or appropriate exposure to sunshine, which permits the body to generate sufficient vitamin D to meet bodily needs. This was our knowledge of vitamin D metabolism until about 15 years ago.

Dr. DeLuca and his colleagues in classical studies supported by NIH were able to demonstrate that vitamin D itself was not the active metabolic component, but rather that a metabolite of vitamin D_3 was responsible for its actions. This metabolite, 1,25-dihydroxy vitamin D_3, is formed in the kidney and functions as a hormone that maintains appropriate serum levels of calcium and phosphorus to support adequate mineralization. Subsequent studies led to an understanding of the regulation of the activity of this potent hormone substance. This knowledge has been valuable in understanding those conditions in which abnormalities of calcium metabolism occur because of an inability to generate the active metabolite of vitamin D, such as in kidney failure. When the kidney becomes disfunctional, the active metabolite of vitamin D cannot be formed, with resulting aberrations in calcium metabolism.

This information has been used to demonstrate the effectiveness of 1,25-dihydroxy vitamin D in treating the calcium abnormalities of individuals with kidney disease. More recently, data have been obtained supporting the idea that osteoporosis of the aged and osteoporosis of the post-menopausal woman are related to a reduction in the ability to absorb calcium, which is related to an insufficiency in the vitamin D hormone.

The work by Dr. DeLuca has led to an understanding of vitamin D metabolism and the promise of a truly great improvement in our ability to cope with metabolic bone disease. The investment in this basic research has paid handsome dividends.

A second example that was selected was the work of Dr. Romsos, who has been studying a basic metabolic defect in genetic obesity in an animal model, the genetically obese mouse. It has been observed that the animal predisposed to obesity by virtue of its genetic make-up; namely, the animal that is homozygous for the obese (ob) gene. The ob/ob animal has a significantly lower heat production than its lean littermates. In studies supported by an NIH grant, Dr. Romsos has been attempting to identify the biochemical lesion responsible for this difference in heat production. He and his colleagues have hypothesized that the defect may be related to a difference in the activity of Na,K^+-ATPase, the enzyme responsible for the translocation of sodium out of the cell and potassium into the cell. This process utilizes ATP with the consequent generation of heat and, hence, a loss of energy. Dr. Romsos has been able to demonstrate that the activity of this membrane enzyme in muscle of the obese animal is reduced to 50% of the activity found in lean mice. This observation suggests that the obesity observed in the ob/ob mouse is due to a fundamental defect in a single enzyme.

If these preliminary observations are corroborated by future research, the cause of one type of obesity would be understood, and appropriate treatment modalities could be sought. Such basic research clearly needs to be continued for it has the potential of enabling us to understand, and therefore treat, one of the most significant nutrition diseases in the United States.

A third example of basic biochemical research that has contributed significantly to our understanding of nutrition was presented by Dr. Broquist, who has been studying the metabolic pathways involved in the synthesis of carnitine. Carnitine is an important compound necessary for the proper oxidation of lipids. Basic research supported by NIH has contributed to our understanding of the pathways of carnitine biosynthesis. This compound is synthesized from the amino acids lysine and methionine. Methionine is known to contribute to the N-methyl groups of carnitine (B-hydroxy-a-trimethylammonium butyrate). While this compound is readily formed by normal individuals, there is evidence to suggest that individuals ingesting diets inadequate in protein are not able to synthesize adequate amounts of carnitine. Dr. Broquist pointed out that there are also reports appearing in the clinical literature describing cases of carnitine deficiency in man. The information obtained thus far on the synthesis of carnitine will be important in understanding the aberrations related to a deficiency of this compound. For example, there is evidence to suggest that muscle carnitine levels are low in certain types of muscular dystrophy.

The data collected to date demonstrate that the synthesis of carnitine requires the essential amino acids lysine and methionine as well as vitamin C, vitamin B_6, niacin, and iron. Such data lead to a better understanding of the metabolic role(s) of carnitine and, importantly, to the treatment of individuals with biochemical defects that result in the production of inadequate quantities of carnitine.

The final example in this panel represents an area of research having significant potential for contributing to an understanding of some forms of cardiovascular disease. Dr. Harris and his colleagues have observed that a copper deficiency in the chick leads to abnormalities in the formation of aortic tissue. This tissue weakens and results in aneurysm and death. Dr. Harris has been able to demonstrate that copper is involved in the formation of collagen in the vessel wall. In the absence of this trace metal, abnormalities in collagen formation occur with formation of aneurysms and ultimately death.

Dr. Harris' research on the basic biochemical role in aortic collagen formation has important implications with regard to the possible development of cardiovascular disease. Dr. Harris has observed that copper is a constituent of the enzyme lysyl oxidase. The basic studies of collagen synthesis and the role of lysyl oxidase in this process have indeed been a significant contribution. Dr. Harris has been able to demonstrate that copper must be present for synthesis of the enzyme. In the absence of copper the enzyme is not formed; therefore the cross-linking between lysine residues cannot occur, resulting in an abnormal collagen and a weakened vessel wall.

The studies conducted by Dr. Harris and his co-workers suggest that copper is quite important in the production of normal blood vessels in young animals during the early developmental stages. In the absence of adequate copper, abnormal collagen is formed, which might well be the focal point for ultimate development of atheroma. The potential importance of these studies is clear; this basic research has the potential of leading to a better understanding of the possible causes of cardiovascular disease, particularly as it is related to nutrition.

Collectively, the four examples presented in this panel demonstrate the importance of fundamental biochemical research to our understanding of the role of nutrition in the prevention and treatment of disease.

PANEL IV: NUTRITIONAL AND ENVIRONMENTAL PRACTICES: CONSEQUENCES FOR HEALTH

Panel leader: E. H. Ahrens, Jr., M.D.
Professor
Rockefeller University

Panelists: Attallah Kappas, M.D.
Professor and Physician in Chief
Rockefeller University Hospital

Gerald E. Gaull, M.D.
Chief, Department of Human Development and Genetics
New York State Institute for Basic Research in Mental Retardation

This panel addressed some important relationships between the health of man and his environment, in this case the environment being nutrition.

Dr. Kappas spoke about the actions of nutrients on certain key regulatory enzymes that govern the disposal of drugs, carcinogens, and environmental pollutants. This major new direction for nutrition research has developed from studies in man himself. The impact of the balance of protein/carbohydrate calorie intake on the speed with which drugs (antipyrine and theophyllin) are metabolized, namely their turnover rates, was discussed. Second, the effects on human subjects of different ways of food preparation, such as the charcoal broiling of meat, by investigating its influence on the metabolic disposition of phenacetin was discussed. Dr. Kappas presented extensive studies with these drugs as model substrates for the P450 and P448 systems. Theophylline and phenacetine probably are substrates representative of the type of chemicals that would be metabolized by the P448 hemoprotein system. Antipyrine phenylbutazone and other compounds are the kinds of substances that would be metabolized by the P450 system. In a way these compounds may perhaps be considered to be prototype agents reflecting the ability of certain hemoproteins to metabolize drugs and to metabolize carcinogens.

Normal volunteers were studied for 8 weeks, with the time divided into four periods. In period one, the subjects ate whatever they chose under ordinary circumstances at home. Period two consisted of a hospital diet of low-carbohydrate high-protein intake (all meals were eaten at Rockefeller University Hospital). Period three was the reverse of period two. Period four was the same as period one. Studies on the plasma half-life of antipyrine were carried out throughout the four periods. The plasma half-life of antipyrine was markedly diminished during period two, which is the period of high-protein intake, and there was a reversal of this process when the protein content of the diet was diminished and the carbohydrate content returned to the levels characteristic of the subjects' home diet. Although there was some variation among the half-lives of antipyrine in the various subjects under study, all individuals responded with a markedly enhanced rate of metabolism during the high-protein period and a reversal of this process during the low-protein high-carbohydrate diet. In additional studies, changes in the combination of high-protein low-carbohydrate or high-carbohydrate low-protein influenced drug metabolism more than changing the intake of protein only or carbohydrate only.

In another study, the metabolism and disposition of phenacetin was investigated by varying the preparation of meat in the diet of human subjects. The subjects were again studied for four periods. In period one, the subjects ate a home diet. During period two, a charcoal-broiled steak and hamburger diet was followed. In period three, the meats were cooked away from the flame and placed on a simple aluminum wrapping to protect them from the volatilized products of the broiling process. Period four was the same as period one. All cooking took place for the the same length of time. There were marked changes in the level of concentration of phenacetin reached within 1 hour of all 10 subjects in each of the four test periods. The peaks reached during period two, when the subjects ingested the charcoal boiled meat, were almost 90% lower than the peaks reached during the control diet and very substantially lower than during period three when the meat was protected very simply with the aluminum foil. This decrease in the peaks indicates an extraordinary increase in the rate of metabolic disposition of the drug. Since the half-life of the drug did not change, the findings may indicate an effect on the metabolism of phenacetin in the intestine or during its first passage through the liver.

Another finding of interest in relation to these nutritional-pharmacological interactions is that certain vegetables can substantially alter the rates of metabolism of antipyrine theophyllin and phenacetin in man. Comparable studies to those presented above were carried out in 10 normal volunteers utilizing three experimental diets, one of which contained 150 grams of brussels sprouts and the control diets, which contained equivalent amounts of peas and lettuce. The results from these studies indicate that the metabolism of phenacetin and antipyrine was substantially enhanced during the test period (brussels sprouts diet) though to a lesser degree than in the charcoal-broiled diet studies. In addition, the conjugation rate of the phenacetin metabolism was substantially increased during the test period, a finding that has not been observed with other foods.

Thus, specific vegetables, the manner of food preparation, protein and carbohydrate content of the diet, trace metals, and undoubtedly other nutritional factors all have powerful influences on microsomal enzyme systems that biotransform drugs, carcinogens, environmental agents, and hormones.

The proximate chemical mechanisms by which these nutrition-evoked changes in drug metabolism occur are not known. They could reflect the action of the specific macronutrients themselves, i.e., the carbohydrate and the protein, or reflect their ratios in the diet; the effects of chemicals associated naturally or by artifact with these macronutrients or certainly in the charcoal-broiled beef studies the actions of combustion products of the meat itself or of the volatilized components of the meat, which become adsorbed to the meat during broiling. In any case, a very wide range of possible mechanisms by which nutritional components can influence human drug metabolism and thus alter the biological or toxic actions of chemicals must be taken into account in evaluating these phenomenona.

It is of considerable medical importance to analyze, to the extent possible, such mechanisms in clinical studies, and indeed this appears to be a potentially fruitful area of the clinical pharmacological investigation. For example, such nutritional pharmacological interactions may occur in individuals who undertake weight-reducing regimens of unusual type, in malnourished subjects, in post-operative patients who receive glucose intravenously as a sole source of nourishment, in individuals with special dietary restrictions (such as vegetarians), and in large numbers of patients whose illnesses--such as diabetes, obesity, uremia, and cirrhosis--require or are associated with significant nutritional restrictions.

The studies described by Dr. Kappas raise the possibility that these various groups might show substantial deviations from the normal in the rates at which they metabolize or respond therapeutically to drugs and other chemicals.

Dr. Gaull presented certain newly discovered effects of formula feeding on newborn infants: more precisely, of the ingredients of manufactured formulas versus those in breast milk. Recent experiments have highlighted the important role that dietary taurine may play on the development and function of nervous tissue in the newborn, and biochemical effects of the lack of taurine in cow's milk formulations.

Taurine is a sulfonic amino acid that is not incorporated into protein. It is ubiquitously distributed in the animal kingdom, but virtually none is found in the vegetable kingdom. Although it was identified in biological fluids before the turn of the century, it is involved in only one known biochemical reaction: the conjugation with cholate to form the bile acid, taurocholate.

Dr. Gaull described his studies on protein requirements in the preterm infant. He found that there were striking decreases in the urine and plasma taurine of such infants fed formulas derived from bovine milk as compared with infants who were fed pooled human milk. Gaull and coworkers postulated that taurine might be an essential amino acid in man because when the diet was virtually devoid of taurine it was impossible to replenish the body pools. The enzyme that is thought to be rate limiting in the synthesis of taurine is cystinesulfinic decarboxylase. Both mature and immature human liver has a very small capacity to synthesize the amino acid. Rat liver on the other hand has a capacity about 1000 times that found in human liver.

Since there was a dietary requirement for taurine, the milks of various species were examined and found to vary in their concentration of taurine. However, bovine milk, the starting material from which infant formulas are made, has very little of this free amino acid.

Why is taurine important? In the human fetus taurine is the free amino acid present in the highest concentration. Even in mature brain it is one of the free amino acids present in very high concentrations. The concentration of taurine in the brain of the human fetus is about six times higher than that found in mature human brain. Similar results were found when the brains of a variety of species were examined; i.e., the newborn brain has a higher taurine concentration than adult brain. In the monkey, the concentration of brain taurine decreases slowly over the first 7 to 8 months of life, whereas the concentration of taurine in fetal liver falls precipitously after birth. This slow postnatal decrease in brain taurine concentration is found in the rabbit and in the rat as well. It is possible that taurine may have a special role in the development of the brain.

The contribution of milk taurine to brain taurine was investigated, using the lactating rat as a model. After injection of ^{35}S-taurine into the lactating dam, taurine is transferred to the organs of the pup. In the liver it reaches a maximum on the first day and then falls off gradually. In the brain, in contrast, it reaches a maximum in 5 days, but then there is virtually no exchange of the radioactive taurine. The neonatal brain seems to hold onto taurine avidly. Taurine is probably of importance in the function of the retina and optic system as well, since taurine deficiency in the cat results in retinal degeneration. Furthermore, taurine undergoes rapid axonal transport in the goldfish optic system.

With regard to the problem of the role of taurine in nutrition, studies are needed in the following areas: 1) the role of taurine in cell biology; 2) the pathogenesis of retinal damage; and 3) better models for the study of infant feeding since experiments involving direct study of organs cannot be done in human infants. Clearly, there has been no epidemic of blindness in human infants, but this is not the point. There is a need to develop a better understanding of the role of taurine in cell function. With such basic knowledge, finer methods for the assessment of the nutritional significance of taurine can be developed.

The content of this panel's presentation is illustrative of the role of patient-oriented research in opening up new vistas and new viewpoints on nutrition and human health. Its central theme is the challenge of putting important questions to man himself as the subject of study, and the pressing need to encourage an extension of clinical nutrition research as an essential foundation for continued improvements in man's well-being.

PANEL V: NUTRITION AND PERFORMANCE

Panel leader:	Hamish N. Munro, M.D., D.Sc., M.B. Professor of Physiological Chemistry Department of Nutrition and Food Science Massachusetts Institute of Technology
Panelists:	John E. Canham, M.D. Colonel, Medical Corps Commander, Letterman Army Institute of Research
	John Daly, M.D. Assistant Professor, Surgery M. D. Anderson Hospital Texas University Medical School
	Janina Galler, M.D. Department of Psychiatry Boston University Medical Center

This panel emphasized the long-term goal of nutrition to support optimal performance throughout life. Dr. Munro pointed out that aging begins whenever growth stops and that it continues throughout adult life. In the adult, there is a continuous reduction of lean body mass, which is related to reduced tissue function. Three aspects of the aging process are relevant to nutrition: first, the role of nutrition in mitigating the progressive loss of tissue function with aging; second, the responsibility of nutritional factors for the accumulation of chronic diseases such as atherosclerosis, osteoporosis, cancer, etc.; and third, the nutritional needs of the old in order to maintain functional competence and reduce disability.

With regard to changes in body functions during aging, the questions raised are: What do we know about changes in bodily function during aging, and are there possibilities of retarding these changes by nutritional means? Aging is not a phenomenon confined to those over 65 years of age or any other arbitrarily chosen age. As measured by ^{40}K, there is a continuous loss of body cell mass from age 25 years onward, which is accompanied by a progressive and often serious reduction in physiological functions. Some tissues are more affected by age. Thus muscle accounts for 23% of body weight at birth, whereas in the young adult it represents 45% of weight, thereafter declining to less than 30% of total weight in those over 75 years of age, even in athletes. At the cellular level, the capacity to regulate metabolism is reduced by aging. The time taken to induce enzymes by hormone administration becomes progressively longer in older animals and the numbers of receptors on many types of cells are fewer. Indeed this may largely account for the slower response to hormones. Capacity of cells to divide in response to mitogens declines with age, which is part of the general impairment of immunological responses with the aging process. Malnutrition is well known as a cause of impaired immunological function, suggesting that the interaction of nutritional status and immunology in the elderly would be well worth exploring.

The relationships between nutrition and the occurrence of degenerative diseases have long been explored as an important research area. Such diseases include arteriosclerosis, hypertension, cancer, diabetes, and degenerative diseases such as osteoporosis. In this context, two points can be made. First, the proportions of adults displaying some form of chronic disease increases with age. It thus becomes more and more a policy of perfection to recommend dietary allowances for the healthy elderly adult. Second, because of the increasing incidence of chronic disease with aging, it is likely that, as age progresses, requirements for nutrients will show an increasing range between individuals.

In addition to the role of diet in the natural degenerative changes in adults and in the incidence of disease, it is essential to determine the nutrient needs of adults who are already old. Little is known about these, as indicated by the subdivision of adults into two groups in the Eighth Edition of the Recommended Dietary Allowances (RDA) handbook, namely 23-50 years and 51 years onward. This is a tribute to the poverty of data in the later years of life. Despite this, however, extensive changes in dietary patterns take place in later life. We therefore ought to know how much of each nutrient is needed at 65, 75, and 85 years, a span over which energy intake can fall by 20 percent.

A major nutritional aspect of aging is the progressive reduction in voluntary intake of energy, due to some extent to loss of active tissue but more importantly because of reduced physical activity. The reduction in energy results in a smaller total food intake, which can involve a reduced consumption of many nutrients. In addition, increasing chronic illnesses affect the patterns of nutrient intakes and needs among the elderly. Of special importance, in addition to energy needs, is more information about requirements among the elderly for ascorbic acid, calcium and vitamin D and its metabolites, and finally protein.

Our knowledge of energy needs with aging comes from surveys of various populations. Many of these surveys have been targeted on selected groups, frequently disadvantaged. However, a study made in the Baltimore area covered businessmen over the age range of 20 to 99 years. From an average energy need of 2700 kcal/day at age 30, energy needs declined steadily to 2100 kcal at 80 years. This was accounted for by a small reduction in basal energy metabolism (200 kcal, paralleling the reduction in lean body mass) and a much larger decline in physical activity (400 kcal) over this age range. Other studies emphasize the low intake of older people. Thus, in nursing-home cases in Colorado, a group has reported average intakes of 1720 kcal and 1330 kcal respectively for elderly men and women. These actual intakes are about 70 percent of the allowances for energy recommended for people over 50 years of age in the Eighth Edition of the RDAs.

With regard to ascorbic acid needs and intakes among older people, an allowance of 45 mg ascorbic acid was recommended in the Eighth Edition of the RDAs, and this will be raised to 60 mg in the next edition. Although the Baltimore survey of middle-class executives showed an average daily intake of more than 100 mg, the Ten-State Survey revealed much lower average intakes accompanied by plasma levels of ascorbic acid that were below the minimum in 10% of men. A study of old people in Britain also disclosed levels of ascorbic acid in blood leukocytes that were half those in young adults, being especially low among the nursing home elderly. The leukocyte level rose to near normal when the diet was supplemented with 80 mg ascorbic acid daily. There is, however, no evidence of any benefit to such cases when ascorbic acid supplements of this magnitude are given over long periods.

Third, we should examine the iron needs of the elderly, since anemia due to iron deficiency still occurs in the United States. Mild iron deficiency anemia can still be seen in Western countries, notably among infants, boys around puberty, and women during the reproductive period. For men of all ages and for women over 50 years, the RDA is 10 mg. However, women under 50 years are advised to take at least 18 mg daily, which most fail to achieve from their customary diets. Thus, during the reproductive years, women tend to have low iron stores, indicated by low levels of serum ferritin that begin to rise after the menopause. In the Seattle area, iron deficiency was found to be common in women in the reproductive period but not after 50 years of age, whereas other surveys, including the Ten-State Survey, suggest that the average iron intake among older women is marginal, from which it can be concluded that some must be well below the recommended intake. In a British study, serum iron and iron-binding capacity was reported to be low in 13.2% of elderly women. In order to provide adequate absorption of dietary iron, it is now recommended that two factors be present in the same meal as the iron, namely ascorbic acid and animal protein, both of which improve iron absorption.

Fourth, we must assess the status of calcium and vitamin D among older people. Among older people in developed countries, osteoporosis with eventual collapse of vertebrae and fracture of the neck of the femur is common and distressing. Many older people appear to have unacceptably low intakes of calcium, and there is also evidence that vitamin D intake by the elderly is low. Additionally, most elderly are likely to obtain little additional vitamin D from biosynthesis in the skin due to exposure to sunlight. All these factors contribute to the slow loss of calcium from the skeleton, but additionally the studies of Linkswiler and her colleague raise the question of whether high intakes of dietary protein are a significant cause of osteoporosis. When extra protein was added to an experimental diet, she observed extra losses of calcium in the urine accompanied by a negative calcium balance. It has also been found, however, that this loss of calcium does not occur if meat is the source of the extra protein, probably because of the compensating action of the extra phosphorus contained in the added meat. It is thus of considerable importance to determine how significant our habitual high intake of protein is in contributing to the frequency of osteoporosis in the United States.

Finally, the status of protein as a requirement needs to be re-evaluated. Nitrogen balance studies suggest that some of the elderly need more protein to maintain body protein equilibrium, even if the average needs for maintaining N equilibrium may not exceed those of younger subjects. This question requires further study on larger groups: a slow erosion of body protein, insufficient to be detected by the balance method, could cumulatively be important over decades. Two additional factors should be considered in relation to the protein needs of the elderly. First, nitrogen balance is affected by energy balance as well as by protein intake and some elderly subjects consume diets that are very low in energy. They may thus have periods of negative nitrogen balance from inadequate energy intakes if protein intake is also marginal. Second, among older people illnesses occur with increasing frequency and can cause stress-induced losses of body protein that have to be restored from dietary protein during convalescence. This period of restoration of tissue protein adds to the need for dietary protein. Finally, the adverse effect of dietary protein on calcium balance, referred to above, suggests that it may be undesirable to persistently consume large amounts of protein. Since adults tend to consume the same percentage of energy as protein, this may result in intakes among older people being low because of the reduced caloric intake.

These examples demonstrate how ignorant we are of the needs of older people for individual nutrients. The importance of obtaining estimates of nutrient needs for health is quite apparent in the case of osteoporosis, where three nutrients (calcium, vitamin D, and protein) are suspected of being contributory factors over long periods of adult life. Even so, it may turn out that the major factor in this disease is the inability of the body of the older person to convert vitamin D to its active metabolite. This example also indicates the major objective of nutritional study of the adult and the elderly; namely to identify nutritional conditions leading to optimal health and function over as much of the life-span as possible. Subsequent presentations reiterate this theme.

Three presentations illustrating different ways in which nutrition influences function followed this introduction. First, Dr. Daly emphasized the role of nutrition in the management of disease, where the capacity of the tissues (including the cells of immune competence) to react to the disease process can be impaired by malnutrition. In a series of patients with cancer studied at the University of Texas, those who showed loss of immune competence (failure to respond to antigens applied to the skin) had a less favorable outlook and a higher mortality rate. Such patients generally had lost weight and showed other signs of malnutrition. Their capacity to respond to chemotherapy and other treatments and their survival were much improved if they were given rigorous nutritional treatment, often in the form of parenteral solutions. Such nutritional treatment usually restored immunocompetence, which thus becomes an index of the degree of malnutrition and a measure of its reversal. The success of vigorous nutritional support in other cases of malnutrition secondary to disease was also emphasized in an addendum by Dr. Blackburn of Deaconess Hospital in Boston, who pointed out that conditions other than cancer (e.g., severe sepsis) also can lead to malnutrition reversible by adequate nutrition therapy.

Next, Dr. Canham discussed the relationship of nutrition to physical performance. Studies of body composition in relation to physical fitness show that obesity results in a reduced capacity to perform physical tasks.

The opposite is, however, not necessarily true. Individuals living on restricted caloric intakes begin to lose work performance capacity after weight loss exceeds 5 to 10 percent. Efficiency of work performance also declines when subjects are deficient in many individual nutrients such as thiamin, vitamin A, and vitamin B_6. These studies thus emphasize the need for good nutritional status in order to achieve optimal work performance.

Malnutrition also affects mental performance as evidenced by the final speaker in this panel, Dr. Galler. As has been repeatedly documented, malnutrition early in life can affect mental function. However, the interpretation of such effects is complicated by the social deficits that frequently surround such cases of malnutrition. The persistent effects of chronic malnutrition in a population is illustrated by her studies on a rat colony subjected to prolonged malnutrition for many generations. Rats born to mothers malnourished for several generations can be made to grow normally by fostering them to well-nourished lactating females. Such rehabilitated animals also show normal activity patterns, but the capacity of the infant rat to find its nest and its ability to learn remain impaired. Such deficits persist for up to three generations in such rehabilitated animals. Thus malnutrition can have long-term effects that carry over to later generations, presumably through subnormal performance during pregnancy and lactation, which perpetuates the early malnutrition of each generation.

In conclusion, it is apparent that we need to explore in a comprehensive and sophisticated way the impact of nutrition on tissue function throughout life. This has now become a major objective for the advancement of nutrition knowledge in the 1980s. The presentations by this panel indicated the complexity of the problems to be explored, and also the rewards to be obtained from a vigorous attack on the area of nutrition and long-term function.

PANEL VI: NUTRITION AND BEHAVIOR: INTERACTIONS

Panel leaders: Alfred Harper, Ph.D.
Professor, Department of Biochemistry
University of Wisconsin, Madison

Eliot Stellar, Ph.D.
Provost
University of Pennsylvania

Panelists: Paul Rozin, Ph.D.
Professor and Chairman, Department of Psychology
University of Pennsylvania

Alan N. Epstein, M.D.
Professor, Biology
University of Pennsylvania

Richard J. Wurtman, M.D.
Professor, Laboratory of Neuroendocrine Regulation
Department of Nutrition and Food Science
Massachusetts Institute of Technology

The biochemical basis of behavior, the way behavior may influence nutrition, and the way behavior may be influenced by nutrition are subjects about which the unknown far exceeds what is known. They are subjects with great potential for development during the 1980s. The panel dealing with this subject discussed a few of the advances made during the past decade that have opened the way for moving the subject of relationships between nutrition and behavior from the realm of speculation to that of objective investigation.

The subject was introduced by Dr. Stellar, who emphasized that eating behavior is the initial and critical step in the nutrition of organisms and that control of eating behavior is mediated via the central nervous system. Food intake and food selection are basic biological drives that are essential for the survival of all organisms. They are also important aspects of the hedonic experience of human beings and may be associated with pleasure or pain.

The normal pathway for obtaining nutrients is through oral ingestion, which involves: sensations of taste and smell associated with ingestion of food; gastrointestinal responses to the bulk, osmotic pressure, and other physical characteristics of the food; and metabolic responses that follow after absorption of nutrients. Signals arising from each of these processes impinge upon the central nervous system to generate feeding behavior. These are the processes that are ordinarily studied in investigations of feeding behavior.

Some of the stimuli to the central nervous system associated with normal feeding can be bypassed or exaggerated experimentally. Intragastric feeding can be used to eliminate taste and smell as variables; intragastric loading of the gut can be used to control osmotic and chemical stimuli and distention. Effects of modifying these variables on responses of the central nervous system can be monitored.

Some of these techniques have been used in experimental studies on human subjects. An apparatus was developed at the University of Pennsylvania that would enable a person in one room to operate a pump to deliver a liquid formula from a reservoir in an adjoining room directly into the stomach via a naso-gastric tube. The person could not see, smell, or taste the food, so visual and oral cues were eliminated. Subjects using this apparatus, which delivered the formula directly into the stomach, regulated meal size essentially as they did when the formula was consumed by mouth.

Animal preparations have been used extensively to study the effects of oral variables on ingestive behavior. In one of these a fistula is placed in the esophagus so that whatever the animal drinks will drain out through the fistula without entering the stomach. A second tube is placed to deliver fluids directly to the stomach. If the solution delivered to the stomach contains the same substance and in the same concentration as that offered to the animal, the animal drinks in normal fashion. If the substances are different it is possible to examine effects of post-ingestional variables on ingestive behavior independently of effects of oral variables. In other studies, Dr. Dudrick developed a method of feeding puppies through an in-dwelling venous catheter. Sufficient amounts of nutrients to support normal growth could be delivered by this technique. This has made it possible to study effects on oral intake of providing different types and quantities of nutrients intravenously. These represent just a few of the techniques that have been used to investigate relationships between various stimuli and feeding responses and other behaviors mediated by the central nervous system.

The operation of the central nervous system in the control of food intake is complex. The critical region of the brain in which information that influences feeding behavior is integrated to provide the appropriate ingestional response is the hypothalamus. To oversimplify greatly, in the lateral area of the hypothalamus there are excitory mechanisms that result in initiation of feeding. In the ventromedial area there are inhibitory mechanisms that function as satiety mechanisms. The hypothalamus receives information via the nervous system about sensory stimuli that affect taste and smell and about physical and chemical changes in the internal environment. Also, the hypothalamus lines the third ventricle of the brain and is highly vascularized so the internal environment impinges very directly upon the body. It is subjected to a continuous flow of information about the state of the body and the influence of ingestion of food or lack of ingestion upon it.

The output of the hypothalamic region leads to feeding or the cessation of feeding and, thereby, to control of the nutrient supply of the organism. It lies adjacent to the pituitary and regulates the flow of neurohormones that initiate release of pituitary hormones. Through these a link is provided between the brain and the entire endocrine system, and, thereby, the hypothalamus serves as a regulator of metabolism.

The importance of this system in a variety of physiological regulations deserves emphasis. It is important not just in the regulation of food intake but in the regulation of thirst, of temperature, of sexual behavior, of aggression, and of many other behaviors that have a motivational quality. Motivation is important in getting organisms to or away from nutrients. This system, which influences motivation, seems to operate in relation to various hedonic experiences in both man and subhuman species to ensure that basic needs for survival will be met.

Dr. Epstein emphasized that study of ingestive behavior, which includes drinking and specific appetites for such substances as sodium as well as food intake, is basic to the science of nutrition. In investigations of these types of behavior, neuroscience and nutrition are closely related.

Eating and drinking are caused by enduring states within the brain. Awareness of the need to eat or drink occurs as the result of the perceptions of hunger and thirst that deprivation produces. Sensations in the stomach, mouth, and throat are the peripheral signs of what is essentially a neural process. Hunger and thirst are states of specific arousal within the brain. The basic problem in understanding ingestive behavior then is to learn how the brain recognizes sensations of hunger and thirst and how it generates eating and drinking behavior. This is essentially a neuropsychological problem to which we do not have a solution.

The model described by Dr. Stellar, in which excitatory and inhibitory mechanisms in the hypothalamus are responsive to a variety of signals that arise from both the external and internal environments, has been extremely useful as the basis for organizing thinking and research strategy on the system for regulation of ingestive behavior. Most current research on this subject is concerned with the study of factors that control the excitatory and inhibitory components of the system. These include stimuli arising within the body from the substances ingested, hormonal responses initiated by the ingestants, the genetic endowment, and the experience of the organism.

Dr. Epstein described an example of hormonal control of drinking behavior from his own research. Angiotensin is a peptide hormone that is released into the blood as the result of secretion by the kidney of another hormone, renin. It is a hormone of thirst and, when it is injected directly into the brain in small amounts, elicits drinking behavior. It also elicits a specific appetite for sodium. The experimental procedure consisted of placing in the heads of rats a stainless steel tube that opened into the cerebral ventricle. Solutions could then be infused directly into the brains while the animals were fully awake and capable of normal behavior.

Rats were infused intracerebrally with angiotensin continuously for 4 days. They had available to them water and a 3% salt (NaCl) solution and their usual food. Ordinarily rats drink between 20 and 50 ml of water a day. After injection of angiotensin into the brain, the animals drank up to 300 ml of water per day, a truly massive amount. Even more striking was the fact that they also drank up to as much as 100 ml per day of the salt solution. This is particularly unusual because, without the injections, the rat will completely reject the salt solution. Of further interest is the observation that this type of drinking behavior persisted even after infusion of the angiotensin was terminated. This implies that the hormone initiated some change in the brain and in drinking behavior that endured for many days thereafter.

These observations provide an example of the type of research that contributes to understanding of the mechanisms involved in regulation of drinking and eating. They also provide information that bears on relationships between salt intake and certain human diseases.

The subject of the influence of behavior on nutrition was addressed by Dr. Rozin, who focused on information about the basis for selection of foods, in contrast to the general theme of the panel, control of the amount eaten. The basis for food selection is one of the least understood areas of nutrition. Even techniques for effective study of the subject remain to be developed.

Understanding of food selection is essential because, as Dr. Stellar pointed out, nutrients ordinarily enter the body via the mouth, and, almost invariably, this is accomplished by some voluntary action. This action represents a behavioral response.

Scientific knowledge about the nutritional value of foods applies only after the food has been consumed. If people would eat highly nutritious and inexpensive foods that they now reject and if they would avoid harmful substances that they now eat, solutions to many of the world's major nutritional problems would be simple. To accomplish this is a behavioral problem and one with which we have not been very successful.

Humans are omnivores, and there is one fundamental problem that affects all thinking about how omnivores select food: There is no way to describe physically and chemically in simple terms all the foods that are acceptable to an omnivore. It is not possible to distinguish what is acceptable from what is not in terms of a simple receptor model. An omnivore must discover what is edible and what is inedible in the environment. Humans and rats and chimpanzees must learn to divide the world through experience into the edible and inedible. There is a third category, the unknown, which eventually, as the result of experience, becomes smaller and smaller.

There are three possible sources of information that can guide an omnivore in choosing food. One is genetic; that is to say, information passed through the genes. Although omnivores do not have a genetically determined receptor that recognizes food, mechanisms that provide some clues are built in. There are receptors that bias man and the rat, and probably other species, toward eating certain things and avoiding others. In particular, receptors that give rise to a sweet taste are present in humans from birth, and substances giving rise to that taste produce a feeding response. This makes sense in the natural world because sugars that produce this response are nutritive substances even though they have a bad press these days.

There are also receptors in the mouth and the nose that are bitter and irritant receptors. These inhibit consumption of certain foods and natural substances, some of which are dangerous. In general, there is a high correlation in nature, although not a perfect one, between bitter and irritant tastes and harm to the body. These innate, genetically determined preferences may be reversed in the human species; many people come to like bitter substances such as coffee and irritant substances such as chili pepper. This phenomenon is unusual in the animal kingdom.

The second source of information that is used in identifying what is edible might be called individual experience; that is, the continuous interaction with foods throughout one's lifetime. The problem of how people or animals can identify what is appropriate food and what is not has been difficult. The difficulty arose from the fact that, after eating a food that is harmful, negative consequences, such as nausea or intestinal disorders, occur much later, with many other things happening in the interim. The connection between ingestion and post-ingestional effects is remote in time compared with most learning situations in which the connection is close.

During the past 10 years through the work of Garcia, Rozin and others, a mechanism has been identified which provides a solution to this problem in the rat and which seems also to apply to humans. This appears to be a special kind of learning in which tastes and other stimuli initiated by food are associated selectively with gastrointestinal disturbances and nausea. A taste that is initially acceptable can become unacceptable through this association. The system has one other fundamental characteristic. It functions over hours. Unlike most systems with which learning occurs only when there is a very close relationship in time between one event and another, through this mechanism an organism associates, despite a delay of several hours in the response, gastrointestinal effects with something eaten earlier. This system is very effective in teaching omnivores what not to eat.

One would think that positive preferences would develop after eating something that produces nutritional repletion. It has been difficult to demonstrate this. It is still a puzzle as to how acquired food preferences develop. While it obvious that feeling worse after eating a food inhibits consumption of it, it is not obvious that feeling better after eating a food stimulates consumption of it.

The third route through which humans, in particular, learn about food is through culture. Most humans reject most foods or accept most foods the first time they are offered them, not because of their individual experience, but because culture has made them either unacceptable or acceptable. In the simplest case culture makes a food unavailable so it is not part of the dietary. We know very little about this area, but it is one that is under active investigation in the burgeoning field of nutritional anthropology.

One can assume that culture passes information along on the basis of earlier experience. Lactose-intolerant individuals learn to avoid milk because they get gastrointestinal symptoms after drinking it. One might, therefore, assume that the reason milk does not appear in Chinese culture reflects the fact that Chinese as a group are lactose intolerant. But this has not been established and, in any event, whether it is a beneficial development is questionable. In fact, culture can misguide. Excessive rejections occur, such as the rejection of insects in many cultures. Also, the rejection of all milk products occurs in Chinese cuisine even though such products as cheese contain very little lactose and are readily metabolized. Transmission of nutrition information through culture is a two-sided coin. It involves the transmission of nutritional wisdom and the transmission of misinformation.

It will be important, in the future, to study interactions among these three systems: the innate or genetic determination of food selection; individual experience; and information transmitted through culture to an individual about what to eat and what not to eat.

Dr. Harper summarized several different trails of research on amino acids that are converging with a focus on relationships between nutrition and behavior. The first of these had its origin at the University of Wisconsin in the 1940s when pellagra, a nutritional disease resulting from niacin deficiency, was being studied intensively and the amino acid tryptophan was shown to be converted into the vitamin niacin in the body. The effectiveness of tryptophan as a substitute for niacin was found to be influenced by the quantities of other amino acids in the diet. Investigations with rats of the reason for this led to observations that certain types of disproportions among the amino acids in diets resulted in depression of the food intake and altered food preferences. Rats were shown to select specifically for a diet with a balanced amino acid pattern over one with an unbalanced amino acid pattern if they were offered a choice between two such diets. This represented a behavioral response to alterations in the amino acid composition of the diet.

Mellinkoff at UCLA noted at about the same time that low food intake of patients with certain diseases was often associated with an abnormal pattern of amino acids in blood. He proposed that the abnormal blood amino acid pattern might initiate a signal to a center in the brain involved in control of food intake that would lead to reduced food consumption.

Another trail of research bearing on nutrition and behavior arose from studies of patients with the hereditary disease, phenylketonuria, a genetic defect of amino acid metabolism. This disease (discussed earlier today by Dr. Scriver) is characterized by accumulation of phenylalanine in blood and body fluids, and leads to severe mental retardation. Investigations were conducted in several laboratories in which animals were fed large quantities of phenylalanine in an effort to simulate the disease. Consumption of a diet rich in phenylalanine resulted not only in the accumulation of phenylalanine in the blood of the animals, but also in a decrease in the concentration of the neurotransmitter, serotonin, in the brain. A high phenylalanine intake also caused poor performance of both rats and monkeys in certain behavioral tests. These observations provided evidence of another link between the quantities of certain amino acids in the diet, amino acid metabolism, and behavior.

Still another link between nutrition and behavior had its origin in studies of the transport of amino acids into cells. Christensen at the University of Michigan found that certain groups of amino acids that competed strongly with each other for entry into cells competed only weakly with other groups of amino acids. He proposed that there were several different transport systems in tissues for amino acids and that only amino acids which were transported mainly by the same system would compete effectively with each other for tissue uptake.

Evidence has been obtained for distinct transport systems for specific groups of amino acids in brain. Although there is a question as to whether the specificity of transport systems in brain is as great as in some other tissues, groups of amino acids will compete with each other for entry into brain. As amino acids are precursors of neurotransmitters that are involved in the transmission of impulses in nerves, one way in which changes in dietary amino acid composition could affect behavior would be through altering the concentrations of precursors of neurotransmitters in brain. This provided a plausible explanation for the earlier observations that consumption of a diet containing a large amount of phenylalanine depressed the serotonin content of brain and resulted in behavioral changes in animals.

In investigations by Harper, Rogers and their associates at the University of Wisconsin and MIT of how disproportionate amounts of amino acids in diets might alter food intake and food preferences of rats, low food intake as the result of a dietary imbalance of amino acids was shown to be associated with low plasma concentrations of certain amino acids and elevated concentrations of others. If several amino acids that were transported into cells by the same transport system were present in the diet in high amounts and their concentrations in blood were elevated while that of another was low, food consumption of the animals was depressed and food preference was altered. These responses were associated with a low concentration in brain of the amino acid in that transport group that was in low concentration in the diet. A dietary supplement of the amino acid that was in low concentration in brain stimulated food consumption and altered food preference. Information about competition among amino acids for uptake into brain slices could be used to predict effects of elevated concentrations of certain amino acids in a diet on food intake or food preference of rats.

Rogers and Leung at the University of California in Davis noted that, when lesions were placed in the prepyriform cortex in the brain of rats, the animals became insensitive to changes in the amino acid composition of the diet. The rats did not curtail their intake of diets containing abnormal amounts of amino acids. These observations provided evidence for the existence of a region in the brain that was involved with the control of food intake and food preference and that was sensitive to amino acids.

Taken all together, these studies showed that high concentrations of certain amino acids in a diet would lead to elevated concentrations of those amino acids in blood; that several genetic defects of amino acid metabolism which resulted in mental deterioration also led to high concentrations of specific amino acids in blood; that amino acids in high concentration in blood would compete for entry into brain with other amino acids that were transported into cells by a common transport system; and that this sequence of events was associated in some way with initiation of a signal to a center in the brain that was involved in control of food intake and certain types of food preferences.

Yet another trail of research bearing on this subject was followed by investigators who were concerned with the way in which the formation and removal of neurotransmitters in brain were controlled. Emphasis in these investigations was on behavior rather than on nutrition. Wurtman and Fernstrom and their colleagues at MIT observed that the concentration of tryptophan in the diet can influence the brain concentration of the neurotransmitter serotonin, of which the amino acid tryptophan is a precursor. However, they noted that serotonin concentration was lower than would be anticipated in the brains of animals consuming a diet high in protein. This was associated with high concentrations in blood of amino acids that compete with tryptophan for entry into brain, indicating that both the amino acid composition and the quantity of protein in the diet can influence the concentration of a neurotransmitter in brain.

Anderson and associates at the University of Toronto observed subsequently that the rat will select between two diets, one having a high and the other a low protein content, to obtain a moderate amount of protein. They noted that this behavior was associated with changes in the concentrations of amino acids in blood of the type observed by Wurtman and Fernstrom in animals fed different amounts of protein. Protein consumption and selection between diets differing in protein content appears, from their studies, to be inversely related to brain tryptophan and serotonin concentrations which, in turn, are determined by the relative concentrations in blood of tryptophan and of amino acids that compete with tryptophan for uptake into brain. They have also observed an association between changes in the concentrations of the amino acids phenylalanine and tyrosine and total food consumption.

Thus, observations arising from several trails of research have shown that dietary amino acid patterns influence blood amino acid patterns in ways that can alter the rate of entry of amino acids into brain; that this in turn can result in changes in amino acid and neurotransmitter concentrations in brain; and that changes in food intake and food preference behavior are associated with some of these changes.

Also, certain diseases, especially liver diseases and genetic defects of amino acid metabolism, result in changes in amino acid patterns in blood resembling those that influence neurotransmitter concentrations in the brains of animals. These are diseases that result in behavioral changes.

These observations on relationships among diet, amino acid metabolism, brain function, and behavior open up the possiblity of greatly extending our knowledge of the biochemical basis of behavior and of relationships between nutrition and behavior during the coming decade.

Dr. Wurtman emphasized that during the past two decades important strides have been made in understanding brain function in health and disease and the effects of various drugs, such as antipsychotics and antidepressants, on behavior through increased understanding of the metabolism of neurotransmitters, the chemical signals that are released from neurons in the brain. Observations that a neurotransmitter is present in larger or smaller amounts, or that a drug releases one or another neurotransmitter in a disease state, provide clues about that disease. For example, Parkinson's disease is associated with inadequate brain dopamine. Schizophrenia seems to respond to drugs that interfere with the action of dopamine. Many neuroscientists accept that an effective paradigm for investigating brain function is to study relationships between behavior and the amounts, turnover, and actions of particular neurotransmitters. This is leading to convergence between the disciplines of neurochemistry and pharmacology on the one hand, and nutrition, metabolism, and endocrinology on the other.

It now appears that, in healthy intact animals after a standard meal, there are predictable changes in the extent of synthesis of one or another of the neurotransmitters by brain neurons and also in the quantities of transmitters that are released from these neurons. This implies a change in the amount of information that flows from one brain cell to another. This is not true for all neurotransmitters but applies primarily to serotonin, acetylcholine and nor-epinephrine and dopamine.

The ability of brain neurons to produce and release these compounds is controlled, at least in part, by what is eaten and when it is eaten. This poses certain enigmas. Why did the evolutionary process lead to this type of control? Why are these neurons responsive to the vagaries of food choice? These observations also provide opportunities that can be exploited during the next decade to increase our understanding of the biochemical basis of behavior and relationships between nutrition and behavior.

Having brain function and neurotransmitter synthesis and release influenced normally by precursors in the diet has some obvious clinical implications. The fact that brain choline level can influence acetylcholine synthesis and that brain tryptophan level can influence serotonin synthesis provides opportunities to use this knowledge in treating disease states that result from inadequate acetylcholine or inadequate serotonin synthesis.

In the disease, tardive dyskinesia, which is characterized by abnormal movements of the mouth, facies, and upper trunk, an inadequate amount of acetylcholine was thought to be released in the brain. However, no treatment of the disease was developed on the basis of that assumption because there are no drugs that can be used continuously to replace acetylcholine. There are no orally active cholinergic agonists. There is evidence now that, by giving patients either choline itself or better, choline the way we normally eat it, namely, as dietary lecithin, in quantities two or three times the upper limit of what they would ordinarily eat, sufficient quantities of acetylcholine are produced to ameliorate the signs and symptoms of tardive dyskinesia. Evidence is accumulating that this treatment may be effective in other conditions in which the basic defect is similar.

These observations open up the possibility of treating other brain diseases that have not heretofore been treatable by using nutrients as drugs; i.e., by giving nutrients that are precursors of neurotransmitters in quantities greater than would ever normally be eaten. This does not represent treatment of nutritional diseases. There is no reason to think that tardive dyskinesia or other conditions that respond to such treatments are of nutritional origin.

Another implication of these observations is physiological. A concept developed particularly in endocrinology is that neurons in the brain can sense changes in metabolites in the plasma. Basically there are only two ways in which this can be done. One is that, if the level of the substance sensed in the blood rises, the neuron can fire faster or slower. The other is that a greater number of molecules of transmitter may be released each time the neuron fires.

If the rat consumes a meal that is rich in calories and low in protein, the concentration of tryptophan in the brain will increase, as also will the concentration of serotonin. If these rats are now given a choice among various diets, substances that cause serotonin concentration to increase will cause animals to choose not to eat carbohydrate but will not interfere with their choice of protein. Some of the neurons that have the capacity to respond by altering neurotransmitter synthesis and release as the result of changes in the availability of precursor from plasma may, thus, be physiological sensors. They have the potential for providing the brain with information about the metabolic state in the periphery, which can then be used as a signal for initiation of feeding, selection of specific nutrients, of sleep and probably other behaviors.

This ability of nutritional precursors to modify brain neurotransmitter concentrations provides neuroscientists with an experimental tool--a rather selective experimental tool--for increasing or decreasing the release of particular neurotransmitters. At present we know little about the function of cholinergic neurons in the brain. Stains that are effective for localizing neurons are lacking, as are selective drugs for manipulating synapses. It appears now, however, that choline or lecithin can be used as probes for studying the function of these neurons. After giving or withholding choline we can observe what behaviors are associated with the treatment.

The fact that brain tryptophan concentration is not controlled directly by the brain but is influenced by plasma amino acid concentrations and that choline concentration in brain is influenced by plasma choline concentration has implications in several disease states. Metabolic diseases that modify plasma amino acid pattern, or plasma choline concentration, may produce changes in brain neurotransmitter concentrations that lead to behavioral changes. There is evidence that changes in plasma amino acid concentrations may contribute to the occurrence of coma in certain types of liver disease. It is also possible that changes in amino acid concentrations in diabetes have behavioral effects.

Finally, there are implications from these observations for what might be called nutritional ecology. It is possible that certain foods, by changing neurotransmitter concentrations, may predispose toward moods, sleepiness, alertness, hunger, and a whole variety of behavioral responses associated with nor-adrenergic, cholinergic, or serotonergic neurons. It is highly speculative but not beyond the realm of possiblilty that we may be able to identify what should be eaten at bedtime to induce sleep or what should be eaten during the day in order to keep from being sleepy or what should be eaten to increase responsiveness to various environmental stimuli.

These are some of the implications of observations between nutrition and neurotransmitter responses that will undoubtedly be examined in detail during the next 10 years.

In concluding the presentation of the panel, Dr. Stellar commented that the observations presented represent an extension of Cannon's concept of the wisdom of the body and suggested that learning and habit may alter brain function in ways that lead to failure of the organism to respond to the body's needs or even to indulge in harmful behavior. It would appear that what we eat can have a more direct effect on the chemistry of the brain than we have previously thought. This opens the avenue for the treatment of brain disorders nutritionally, and suggests that programs of education or behavior modification in nutrition should be based upon knowledge of the role of biological and psychological factors, such as have been implicated in the control of food intake and food preference.

CONSUMER PANEL

Panel leader: Gilbert S. Omenn, Ph.D.
Assistant Director
Human Resources and Social and Economic Services
Office of Science and Technology Policy

Panelists: Robert Choate
President
Council on Children, Media, and Merchandising

Kristen McNutt, Ph.D.
FASEB Congressional Science Fellow
Senate Committee on Agriculture, Nutrition, and Forestry

Johanna Dwyer, D.Sc.
Director, Francis Stern Nutrition Center
Tufts New England Medical Center

Jonathan Meyerson
Acting Special Assistant for Public Participation
U.S. Department of Agriculture

Allan Forbes, M.D.
Acting Associate Director for Nutrition and Consumer Sciences
Food and Drug Administration

Michael Jacobson, Ph.D.
Executive Director
Center for Science in the Public Interest

DR. OMENN:

Let me welcome all the panel members. In the role of consumers, we are delighted to have a chance to appear before you, and especially before the scientists who have already presented a considerable amount of interesting work. After all, the research knowledge that has already been gained over several decades of effort and the research knowledge that is being sought have a considerable audience. There is the general public, and there are people who must advise what foods should be allowed to be sold, or encourage what foods should be provided in the feeding programs about which you have heard in some detail. There are those who must regulate, those who must deal with their patients, and those who must provide information, through the media and other educational mechanisms.

Bob Choate is a student of the media, particularly the use of TV and how we deal with what is deluged upon our audience of children.

MR. CHOATE:

My question to NIH is this: Where are you and where have you been? It seems to me that we have been exposed in the last 25 years to a tremendous number of psychological and behavioral influences in regard to food, and there is much hand-wringing in the nutrition community over the inability of nutrition educators to change food habits; all the while, those forces that are at work on us daily to adapt bad food habits seem to go unstudied and unchecked.

I think present commercial presentations on food are an education course in misnutrition or in malnutrition. Obviously, such advocacy can help in leading to obesity and in causing dental problems; you know better than I the variety of biological problems that can be brought on by continual poor selection of foods.

Let me say something slightly irritating, I am sure, to you: we in this room are elitists and probably should be very wary of the attitude that we hold toward mass media, thinking it is not much of an influence on us, and thus it cannot be much of an influence on the public at large.

Mass media is a huge influence in this country. There are 33 million children who are watching television at least 25 hours a week during their second to twelfth years. There are 40 million functional illiterates in this country who cannot read food or drug labels properly to glean important information from them. These populations in particular have to have our interest and our empathy; but if one is to talk about nutritional illiteracy in this country, I suspect that includes 75 percent of the population and maybe even a substantial portion of this audience.

Who and what are the major influences on our eating habits today? Parents, television, advertising in magazines and newspapers, school systems, peers, and the convenience outlets that may offer us certain foods in certain restaurants without our knowing what really is in them.

Underlying all this is a gigantic corporate effort to seek an ever-greater share of the market. In the United States, $5 billion is spent annually in food advertising, yet we all do have appetites. One really has to wonder why $5 billion worth of advertising is required.

Those of us who work around Capitol Hill see the millions spent in lobbying for the status quo for a restraint on USDA policies that might affect the meat industry or the fat industry. We see huge efforts being made this past month on Capitol Hill to prevent the Federal Trade Commission or the Food and Drug Administration from looking into how food advertising affects vulnerable populations.

Parents, schools, and peers are not escaping TV's influence. They, too, are shaped by it. A moderate television-watching child today in the United States sees between 8,500 and 13,000 food commercials each year. That is 4,200 minutes per year of polished information about food that is being drummed into the nation's children, in a very attractive way. That is 70 hours per year of questionable guidance on food selection, which may well be implanting lifelong beliefs about food.

This is not because there are evil people in the broadcasting world trying to corrupt our food habits. In a private enterprise system, it is only natural that those products with the highest markup are going to get the highest advertising budgets and be seen most frequently on the tube. And it is only natural in a private enterprise system that fish, vegetables, fruit, and those products without a high markup are going to get less touting on the air. Magazines and newspapers tout foods in another direction, and you will notice there, too, an absence of nutrition information.

Comes now USDA, the Federal Trade Commission, and a few other agencies in town, including the Office of Education, starting to discover public service announcements and the possible ways of communicating nutrition information to the public. We see the FTC examining the possibilities of warnings within food ads, compensatory messages attached to food ads, or public service messages to compensate totally for the lack of balance in TV's menu.

But my questions to NIH are these: Where have you been in studying how such messages as commercials impact on vulnerable populations? Where have you been in trying to figure out how to make advisories or public service announcements really meaningful to change behavior and to change attitudes toward food selection?

One has to guide the vulnerable populations of this country, to look for the sins of omission in food advertising, as well as the sins of commission. I will make only passing reference to the fact that TV is a marvelous invitation to abandon exercise and sit and snack.

My concluding statement to NIH is this: Can you not start looking into the behavioral development, the cognitive development practices, now at work through the medium called television? Can you not help us educate the nation's parents to really understand the impact on the nation's young of repetitive food advertisements? Can you not help us raise what I call the QI of American citizens, "the questioning intellect," so that when these polished commercial messages come over the air, the young, as well as their parents, start to question: "Is that food really good? Is that message really honest? What did that message leave out? What more should I be looking for?"

The FTC, the FDA, and now the USDA are starting to prepare public service messages to correct some of the nutritional misunderstandings in this country. I beg them to fund a research program for clinical testing of such public service announcements before they get on the air, because otherwise we will not know whether those messages designed by elitists have the impact we intended upon the populations that we want to affect.

DR. OMENN:

Thank you. That was a succinct and stirring challenge, and you made an appropriate definition of the term "behavioral research" implied in the title of this conference. I think that when we focus on the processes and the dollars, we frequently neglect the content. Of course, the interest of researchers is in the content of the message.

We have in the Senate Select Committee on Nutrition and Human Needs, now a subcommittee of the Committee on Agriculture, Nutrition, and Forestry, a bold effort to define nutritional goals or, more importantly, dietary instructions, saying "Eat more of this and less of that." Kristen McNutt is a scientist working on the staff of that Senate Committee. Perhaps, Kristen, you will address this as part of your remarks.

DR. McNUTT:

I really had not planned to address the question of dietary goals. Rather, I looked at our conference program, and the three specific topics outlined for us to discuss. Of those three, I would like to comment on the role of consumers in determining research priorities.

I think there no longer exists any question about whether the consumer should or should not have a role in determining research priorities. The answer is unquestionably in the affirmative.

You have been flooded with a lot of information today. There are only three points that I would like to leave with you.

First, I find it no surprise that nutrition is the first of the basic laboratory sciences in which we are having a strong consumer input into research priorities. Part of the explanation for this situation is that nutrition has become the "most public" of the sciences. Let's not forget, however, that indeed nutrition is a science.

My second point is based on the fact that consumer input into Federal policy is a growing trend. It might serve us well to look at some of the precedents from the past as we move into expanding this aspect of nutrition planning.

The precedent of consumer input that I see as the best example of an issue close to basic hard science is what we are going through and have already experienced regarding recombinant DNA. Let's learn from that experience.

There are a couple of examples closer to the area of nutrition that might teach us something. The experience of the consumer group that meets with the Food and Nutrition Board of the National Academy of Sciences might help us smooth into our new goal of consumer input into nutrition. Also, Johanna Dwyer recently chaired a panel that developed an excellent report from the Office of Technology Assessment regarding nutrition research priorities. Among her group were several consumers, and she may wish to comment on her experiences there.

My reason for citing these precedents is that I want us to learn from history. Let's go back to these examples and find out what worked well and why it worked well. Let's also be candid enough to say where there were problems and why, and what are possible solutions. Let's not repeat the errors of the past!

For my third and final point, I would like to pick up on what Dr. Omenn has said about the definition of the consumer. I feel strongly that the bench scientist deserves a place in the forum of consumers in this country. As we explore our history to determine how we can improve the nonscientist's input into health planning and into nutrition research, let's also examine the system and see how we can improve the ability of the scientific community to have input into the area of nutrition research priorities and planning.

DR. OMENN:

Our next panelist is Dr. Johanna Dwyer, Director of the Francis Stern Nutrition Center at Tufts, and co-author with Dr. Jean Mayer of a syndicated newspaper column on nutrition.

DR. DWYER:

As Dr. McNutt mentioned, consumer inputs are a "consuming" sort of topic today, and many consumers feel that they have been left out.

I would like to talk about two things very briefly: first, the role of consumers in establishing research priorities, which I think Dr. McNutt has dealt with very well in her remarks; and second, what the content of consumer information and education should be.

We can think of consumer models for research priority setting in three ways, using the analogy of a railroad train. One would be with consumers as the engine, not necessarily consumers themselves, but consumer representatives working through Congress to appropriate funds or to give other sorts of nudges or suggestions. This is one model.

A second model would be to think of the consumers as the caboose, coming along at the end of the priority setting process and really just sort of "koshering" or "blessing" an endeavor in which they really did not have a part. In my view, thinking of the role of consumers being totally involved in stimulating appropriations through Congress (or as a caboose) is not appropriate. Rather, I would agree with Dr. McNutt's remarks that what we need is consumers involved all the way along the line in setting the priorities.

So, I am for a third model, with consumers as passengers, or very much involved in the priority setting endeavor. Exactly where they can function to help, of course, becomes an issue. I think in some places they are more helpful than in others.

This focus on consumers raises two issues: first, how to involve consumers more fully; and second, how to inform consumers about the research process and the results of research.

It seems to me that there are some commonalities on which most of us could perhaps agree. One is that the entire research process needs to be opened up at least to consumer education. In other words, consumers need to understand more about the priority setting process and about the process of doing research, or doing science, if you will.

I would submit that information and education as to the nutrition research process, as well as on findings that are discovered, and the final measures that get into public policy are all vital. Consumers need to be better informed about all these issues.

One very pragmatic reason was shown in a cartoon entitled "Bastille Day in Sunny California," which appeared in the Boston papers right after the voting on Proposition 13. Regardless of what unfortunate things may occur to research and teaching endeavors from indiscriminate tax cuts in that sunny state, there is a lesson here, or perhaps a warning. I believe firmly that if consumers are not more fully involved, we may be seeing this sort of mindless budget cutting in other states. People need to know what their tax dollars are paying for.

I would now like to turn to the problem of consumer information, the second issue I mentioned as being important. In another cartoon, again in the Boston newspapers, one group of consumers has a set of signs that say, "Keep us informed about what we want to know." The other group of pickets add, "But don't tell us things we don't want to hear." And, of course, Dr. Sanford Miller, the new Commissioner of Foods at FDA, is going to have to deal with that sort of double-thinking and confusion on the part of consumers in the near future.

Finally, I would like to come to us as scientists and some of the various styles so well described by Dr. Jack Tizard, the British sociologist, with respect to the ways that we as scientists think about public information and what needs to be communicated. All of us probably can accept, at least to some extent, the notion that the scientist cannot be absolved from some responsibility for communicating his findings and from disseminating them. However, there is a wide disparity just as to how far this should take us. There are several major schools of thought, at least as I see them, with respect to becoming involved with dissemination of information on the research process and participation in public policy.

First, there is the intellectual humility school--people who believe that our present knowledge is so slight that there is little if anything we can tell the public or proffer to government agencies and public policymakers. These people believe that, before scientists do any talking at all, they have to do more research to increase our understanding of basic mechanisms.

Second is the superior understanding school--another group of scientists who remember the old motto, "fools rush in where angels fear to tread," and somewhat complacently believe themselves to be the angels, declining to have any intercourse with the fools. That is, these people believe that we know so much or that the issues to be dealt with are so complex that no scientist worth his salt is going to endorse the inevitably simplistic solutions proposed by policymakers and politicians, much less get any consumer understanding into this process. I suppose the only thing this group has in common with the policy, politician, and consumer advocates is that all the groups believe they are widely misquoted by journalists and whatever they say is likely to be misconstrued by the public as well as other groups!

Neither the intellectual humility school nor the superior understanding school is very vocal in terms of becoming involved with issues of information and policymaking.

The Millenialists or Utopians are a little more vocal. These are people who believe the entire system has to be revamped from top to bottom and telling people any differently is just palliation or piecemeal reform. They are often so vocal that they abandon science entirely for politics or its first cousin, policy.

The scientists of the panacea school believe they can be vocal because they have discovered the philosopher's stone. Of course the philosophers' stones tend to vary from person to person and time to time, but usually this particular type of scientist feels he has an especially potent message to remedy society's ills, and he talks a lot about it.

Finally, there is the tell-it-like-it-is school on the vocal side of the policy arena. These scientists believe that we should tell what we know as best we can, and also tell what we don't know, attempting to be fair. I would recommend your reading, if you haven't seen it, a statement I circulated by Dr. Jules Hirsch and others of the American Institute of Nutrition on the proper protocols for scientific pronouncements by scientists. It seems to me that this is a good guide for what to say and when to say it on research issues. In essence, what it says to be is fair, to report your own work or views, and also to mention conflicting views of other scientists and unresolved issues. This statement is particularly useful, as I see it, for dealing with controversial topics. At least in my mind it is not so narrow as to muzzle or muffle the communication arts.

Finally, I would like to address the business of what can happen to a good scientist, even if he follows these guidelines. The best-intentioned scientist can still be misquoted or the text around a correct quote can be so distorted that one ends up looking like a sensationalist. Now, if Marie Antoinette had said, "Let them eat cake at a birthday party," instead of when talking flippantly about peasants' daily diets, she wouldn't have gotten into all the trouble she did.

I would hope in the next few years that the tell-it-like-it-is people achieve the ascendancy. If scientists don't tell it like it is, other people are going to do the best they can, which is often badly, and not only the scientists but the public as well are going to suffer as a result.

DR. OMENN:

Our next panelist is Jonathan Meyerson from the Department of Agriculture.

MR. MEYERSON:

I would like to briefly outline some of the work that the Department of Agriculture has been doing. A number of people have indicated that we should be doing more, and we should, but for the record I would like to summarize some of the activities in which we have been involved in recent years.

We have reorganized our agencies to spotlight human nutrition functions. We have done a number of things in this area. First, when Secretary Bergland came into office, he recognized the need to have a policy official devoted full-time to the Department's programs that directly affect the consumer. He therefore established the Assistant Secretary for Food and Consumer Services; these activities are now headed by Carol Tucker Foreman. Under the new organization, she manages the $5.8 billion Food Stamp Program, the $2.7 billion Child Nutrition Program, and the $270 million Food Safety and Quality Service. The Food Safety and Quality Service has a very important role. The bulk of the work is to examine the 50 billion pounds of meat that are slaughtered annually. Recently, under the new administration, there has been a lot of work going on putting out regulations on the formation of and requirements to reduce the formation of nitrosamines in meat, to reduce sulfur residues in swine, and other types of needed controls that directly affect the consumer.

Another organizational change is the establishment of a Science and Education Administration. Within the SEA is a Human Nutrition Center, which will provide leadership and coordination for human nutrition.

The Department of Agriculture also has a Nutrition Policy Committee, which was recently formed.

An additional major recent involvement that impacts consumers is the establishment of a public participation program, which will permeate all agencies within the Department of Agriculture. It will be operated through the Office of the Secretary, which will direct the work of each agency through the agencies' separate staffs for public participation. What we plan to do is get to the *public*, get to *consumer groups*, get to *industry groups*, get to anyone who is impacted on a policy decision, *before* we even propose the decision. We have already met with 60 consumer groups and trade associations to get their ideas in forming the new function.

As management expert Peter Drucker once said, "Holding meetings is no substitute for doing real work." And that might apply to conferences, too. However, you have to start somewhere.

Let me now give you some examples of some of the *real* work we have been doing to involve consumers in our programs. One good example: Last November the new law amended the Child Nutrition Act of 1966. The law provided for substantial new nutrition education programs, consisting of grants of over $26 million to state education agencies. This amounts to 50 cents per school child for every state in the nation.

Immediately after the law was passed, USDA reviewed and identified a number of issues that needed to be resolved. A few weeks later, we convened the Advisory Conference attended by state education officials, local school food service personnel, representatives from professional groups, including the Society for Nutrition Education, and officials of other Federal agencies.

We have just sent out authorization to states to provide initial funds for hiring a nutrition education coordinator in each state, and the states will also use these funds to conduct nutrition education needs assessments and to prepare state plans. Each state will use its plan to get money to operate this program. The states are required by law to involve consumers, and they have to tell the Department of Agriculture how the consumers have contributed to their plan of action and how they are going to use the money.

This program indicates that, despite the need to interact with many government agencies at the Federal and state levels, we can get a major new program off the ground fairly expeditiously and still have significant public participation.

There are a number of other examples where the Department has acted recently, under its own initiative and under laws where it is mandated to carry out operations. First, the state health departments are required to have a plan approved by the Department of Agriculture for providing nutrition education to participants in the special supplemental food program for women, infants, and children, commonly known as the WIC Program. Legislation now before Congress, which is supported by the Department of Agriculture, would require that 4 percent of program funds be spent on nutrition education. This will be an important new development to add money to nutrition education. Under this law, over $21 million will be spent in fiscal year 1979 to help inform women about sound nutrition at the most critical time for them and their families.

We have also funded for the first time, and we probably should have done it earlier, a $1 million program under Section 8 of the Child Nutrition Act. Part of these funds will be used to evaluate the effectiveness of the state education agency program.

Another nutrition education program involves the Food Stamp Program. Under the Food Stamp Act passed last year, state welfare agencies are required to provide nutrition education information in public assistance offices, and this is an excellent opportunity to inform the 17 million people who are on food stamps about good nutrition. The Department is developing single-concept printed materials specifically designed for persons with low reading and comprehension levels on how to buy and prepare more nutritious and economical meals and on the relationship between food and good health.

Two other programs deserve mention. First, the Nutrition Media Alert Program is a pilot program to determine what types of nutrition education advertising are most effective on television, radio, and in the newspapers, and it is aimed at kindergarten children through eighth grade. We are going to have three groups, one of which will get complete media coverage: television, radio, and newspaper advertising. The second group will have the same media coverage, reinforced by information given in the classrooms and by parents at home. We are trying to get the parents involved in teaching the children about nutrition because we feel it will be more effective this way. The third group will be the control, which will receive no special education. After the experiment is over, we will survey all three groups to see how effective the TV and newspaper advertising was, and how much the classroom information helped these children to learn about good nutrition.

The other program that we are working on is one with FDA and FTC, designed to help improve labeling of food products. We are trying to find out what the public wants to know about labeling of products. We are having hearings in five cities throughout the country. They are going to start in August and go through October, and they will be in Wichita, Little Rock, San Francisco, Boston, and Washington, D.C.

In closing, I would like to emphasize one area where public participation is of critical importance, and that is in evaluation. We must find out what we are doing right and what we are doing wrong, after the program is in operation. We are going to have a hard time getting more money. Especially in view of Proposition 13, we are going to have to fight for every dollar in nutrition education appropriations, and it is very important we do so. We are also going to have to make the most of what funds we have now and coordinate programs of various agencies, so there is minimal overlap.

DR. OMENN:

As you just heard, there is a tremendous amount of common ground between HEW and the Department of Agriculture. Part of it is reflected in the programs between Agriculture and the FDA. I call now on Dr. Allan Forbes from the Food and Drug Administration.

DR. FORBES:

My remarks will be somewhat analogous to those from the USDA representative. Given that it is reasonable and proper to involve consumers in setting research priorities, it seems self-evident that you can't do that unless you set up a mechanism for ongoing communication with consumers. Over the past few years, we have developed a fairly comprehensive system for doing that, and I thought it might be worthwhile to share it with you.

The first point to make is that FDA receives an enormous collection of inquiries and complaints, and, because of the public awareness of the existence of FDA, the volume of such complaints is truly huge and completely spontaneous in its origin. Quite literally hundreds of thousands of complaints and inquiries arrive at FDA per year. Over half of them are on food issues and over half of those in turn are nutrition related. So we certainly get a good exposure to what the consumer is thinking, at least to those who are willing to write letters.

On a positive note, there are a number of mechanisms that we have established in recent years that we are finding extremely effective. They affect everything we do; that is, these relationships with consumer groups, individual consumers, and consumer advocates affect our research programs, our regulatory programs, and our day-to-day thinking.

One mechanism is that we hold meetings every month or two with a large group of consumer representatives. If you added up the agenda items, again much like the consumer interests in the nation, half are food related and half of those are nutrition related. The agenda for these types of meetings are established by the consumer representatives in advance of the actual meetings.

As a second mechanism, we have a National Food and Drug Advisory Committee, which directly advises the Commissioner and his immediate staff and, of course, the total agency. This standing committee has permanent members representing consumers. Mr. Robert Choate, for example, is on this committee. The consumer representatives surely represent in a constructive and critical way the interests of the American consumer. In addition to performing its general advisory functions, the committee reviews and advises on our grant applications. FDA has a small grant program, which, if hopes are realized, will expand, particularly in the nutrition area.

Throughout the country, in our regional and district offices, we have 55 consumer representatives, formally known as consumer affairs officers, who devote their entire working lives to communicating with consumers throughout the country. On a monthly basis they report back to headquarters and tell us what the consumer is saying from coast to coast. Again, the kinds of responses we get reflect the fact that well over half the consumer concerns are in the food area, and often it is much higher than that. Hence, this is one mechanism whereby we can interpret what consumers are actually saying. We are trying to sophisticate this approach within the Bureau of Foods, aiming toward a permanent tracking system so we can in fact analyze on a continuing basis exactly what the consumer is 1) inquiring about and 2) complaining about. We have never before set up a system where these inputs can be quantitatively analyzed over time. We now have the initial pilot studies underway to determine how best to do it.

Mr. Meyerson has already mentioned the fact that Commissioner Donald Kennedy initiated the series of public hearings on revision of food labeling, and then successfully sought out the cooperation of both the Federal Trade Commission and the USDA. These hearings will commence in late August and last through October, as Mr. Meyerson mentioned. To maximize the substance of the hearings, we are launching a large-scale publicity campaign throughout the summer months with the specific purpose of encouraging grass-roots consumer participation above and beyond all other kinds of input. The second kind of input we are particularly trying to encourage is from the scientific community. Industry is of course welcome to participate, but we are encouraging this segment to provide comments in writing. The major point I want to make is that we are trying particularly to get at the thinking of the grass-roots consumer.

Last but not least is the historical mechanism for consumers to communicate with the agency, which has been going on for many years; that is, the legal procedures of regulating food safety and quality. For each regulatory concept, we publish a proposal in the Federal Register requesting receipt of comments from anybody, from individual consumers through the most sophisticated industry. This mechanism does in fact very clearly influence what FDA does. If you think back, for example, to the vitamin and mineral controversy that we have been in for the last 5 to 10 or 20 to 30 years, depending on where you want to start, the impact of receiving hundreds of thousands of consumer letters was enormous when we proposed that very-high-potency vitamin and mineral preparations should be deemed to be drugs because of the potential or known toxicity. These led to major concerns at the congressional level and ultimately to the passage of the 1976 Amendment (the "Proxmire Amendment") to the Food, Drug, and Cosmetic Act, which limited FDA authority in regulation of dietary supplements. The Amendment specifies that the FDA may not regulate dietary supplements with regard to manufacturers' claims, product quality, misleading statements, or misbranding; thus the FDA can regulate these products solely on the basis of product safety. This in turn has had a tremendous impact on the evolution of our interests in studying nutrient toxicity. So, in this case, there was certainly no shortage of influence of consumers on research through use of the conventional regulatory procedures.

What I hope we can do over time is to improve steadily and to sophisticate and polish our ability to communicate in the clearest way possible with consumers. I hope I have left you with the impression that we at least have a viable system in place.

DR. OMENN:

Now we turn to Dr. Michael Jacobson from the Center for Science in the Public Interest. We have just heard that there is an elaborate system to receive complaints, and I suspect we will now hear some of those complaints. Welcome.

DR. JACOBSON:

In the past 20 years, the American public has spent $30 billion on the National Institutes of Health. This enormous amount of money has trained thousands of scientists whose research has led to an unprecedented understanding of living organisms, the causes of many diseases, cures for some diseases, and insight into how to prevent certain health problems and promote health.

While research is NIH's main task, Congress has given it additional responsibilities. I would like to read several excerpts from NIH enabling legislation, which should be standards against which the Institutes' performance may be measured.

The Act establishing the National Institute of Dental Research charged that agency with doing research and "the useful application of their results with a view to the development and prompt widespread use of the most effective methods of prevention, diagnosis, and treatment of dental diseases and conditions."

The Act establishing the National Cancer Institute charged that agency with "promoting the useful application" of research "with a view to the development and prompt widespread use of the most effective methods of prevention, diagnosis and treatment of cancer. . . ."

The original Act establishing the National Heart Institute in 1948 referred to the "useful application" of research. In 1972, Congress mandated NHLBI to "provide the public and the health profession with health information with regard to cardiovascular . . . disease. . . . special emphasis shall be placed upon dissemination of information regarding diet" and other factors. And the 1977 amendments created the Office of Assistant Director for Prevention, Education, and Control, which would place a "special emphasis" on disseminating information about "factors affecting the prevention of arteriosclerosis and other cardiovascular diseases." There is not even an Assistant Director for Prevention, Education, and Control, let alone information flowing to the public from that hypothetical persons's office.

Though NIH has been criticized, justly I believe, by several members of Congress for not devoting a greater percentage of its resources to nutrition-related research, one must not overlook the great deal of such research that has been conducted. In fact, NIH research has contributed to the growing awareness that a diet high in fat and cholesterol is associated with an increased risk of bowel cancer and breast cancer. Of course, to be concerned about the high intake of dietary fat and cholesterol, we do not have to base a dietary prescription on the cancer work, which for the most part dates back only about 10 years, because there is far greater evidence that a diet rich in fat and cholesterol is a major cause of cardiovascular disease.

I believe that virtually all scientists in the National Heart, Lung, and Blood Institute believe that a high-fat, high-cholesterol diet increases the risk of heart disease. This would only be consistent with Norum's survey of heart specialists, 92 percent of whom stated that our present knowledge of the relationship between diet and heart disease is sufficient to recommend dietary changes. The same percentage, 92 percent, have changed their own diets. Though the diet-heart disease relationship is still often called a "hypothesis," virtually the only opposition to it comes from the meat, egg, and dairy industries, a few scientists who enjoy their support, and a few others who demand absolute proof prior to endorsing policy changes.

In a third area, NIH research has proven and re-proven many times over what the candy industry undoubtedly refers to as the "diet-dental caries hypothesis."

In these three areas--cancer, heart disease, and dental caries--as well as others, NIH is doing precious little to translate publicly funded research into concrete benefits for the public, in terms of information, food label information, revised food standards, and other approaches.

Some NIH-sponsored research does get translated into actual medical practice. Treatments and cures, including pharmaceuticals and medical machinery, are readily accepted. On the other hand, preventive strategies, particularly those based on dietary changes, are resisted. At a hearing last October held by the House Subcommittee on Domestic Marketing, Consumer Relations, and Nutrition, Dr. Fredrickson said:

> "I feel that the problem we still have is that we can't bring you proof [emphasis added] that changing the diet for the average American will lengthen his life or reduce his likelihood of having a coronary."

In a recent Washington Post article, Dr. William Knaus wrote:

> "Why this double standard for technology? Why is it that we accept, on preliminary evidence alone, a procedure whose average cost is $12,500 [coronary by-pass operation], while we demand definitive proof that low-cost and safe preventive measures, such as diet, work before we adopt them?"

Dr. Beverly Winikoff offered an articulate answer to Knaus' perhaps only rhetorical question in a recent paper in Science:

> "Many scientists, intrinsically conservative in terms of deciding when the facts are adequate to prove the case, often resort to the argument that certainty of knowledge, from which one could, theoretically, create policy, has not yet been achieved. This argument is advanced even though absolute proof is an impossible goal. Political and economic opponents of any advocated changes are, of course, happy to espouse the scientists' argument, extremely powerful in a technologically oriented society, that proof is not yet adequate, definitive, or sufficiently general to create policy."

If I may re-state her case a bit less delicately, the use of drugs and medical technology does not hurt anyone's financial interests--except maybe the patient's--so there is no opposition to their use. Quite the contrary, drug and other corporations enthusiastically advocate the use of new technologies from which they will profit handsomely. Preventing a health problem in this day and age, however, often means stepping on the toes of some very powerful industries, industries that do not like to be stepped on, industries that have great influence over legislators and presidents, industries that could probably force cutbacks in the budgets of federal agencies, including even the politically popular National Institutes of Health. Vested interests know that NIH's true love is research, rather than applying the findings of research, and that they can usually win the day by saying, "All the facts are not in yet; NIH and others should do more research." The call "more research" can usually be translated into "less action."

Though more high-caliber research, particularly in human nutrition, needs to be done, *the overriding priority of conscientious and budget-conscious researchers and administrators should be to apply the findings of existing research*. For many questions, such as the relationships between diet and dental caries, heart disease, diabetes, hypertension, and certain cancers, we will probably never know all the details and mechanisms.

NIH scientists and other researchers can continue to sit in the laboratory, but meanwhile people will spend some $3 billion a year repairing decaying teeth. NIH can say nothing, but some 650,000 people will die of heart attacks every year. NIH can opt for more research, but some 80,000 people will die of bowel cancer and breast cancer each year. NIH can continue to pride itself on the quality of its research, but tens of thousands of people will die prematurely of stroke and diabetes each year.

The price of not applying research findings is enormous when translated into human suffering and lives. The public is willing to pour billions of dollars into biomedical research, because it assumes that new knowledge will be used to improve its health. Not using this new knowledge is a direct betrayal of the public.

In the area of nutrition, the risks associated with a diet low in fat, salt, sugar, and cholesterol are nil compared to the harm caused by the pathogenic diet consumed by most people.

As Dr. Albert Stunkard's unheeded report to NHLBI, dated April 5, 1977, said, "The time for action is now."

As I mentioned earlier, NIH was charged by Congress not only to conduct research, but to disseminate and apply the findings of that research. NIH appears to be in violation of the law. I would like to make several recommendations that would bring NIH in compliance with the law.

1. NIH should actively and directly encourage the American people to change their diet and lifestyle in line with the findings of researchers. Various divisions of NIH have had a few poorly distributed,

terribly out-of-date nutrition pamphlets; fortunately, these are being revised, or at least reviewed. The electronic media are virtually ignored. It is interesting and sad to note that, although an NHLBI official wrote to a vice president of McDonald's Corporation saying that NHLBI was "prepared to assist you and the McDonald's Corporation in any way possible," NHLBI officials say nothing to the American public.

2. Second, if NIH officials do not accept the congressional mandate to disseminate information to the public, one would hope that they would at least urge other government agencies to make use of the findings of NIH research. NIH should be encouraging the Defense Department to serve more nutritious meals. It should be urging FDA and USDA to adopt standards of identity and labeling regulations that would promote a more healthful diet. Instead, when I talk to nutritionists at FDA and USDA, they say, "We can't move ahead, because NIH hasn't given us the green light yet." Instead of promoting better health, NIH at times seems to be the major impediment to better health.

3. Congress should earmark a certain, substantial percentage of NIH's funds to be used only for applying and disseminating the findings of the research.

4. Finally, if NIH continues to violate the law by applying only those research findings that do not adversely affect a big industry, Congress should make NIH strictly a research organization by removing all outreach and application activities to another part of HEW or to USDA.

DR. OMENN:

I wish to thank each of the panelists for a lively session and a bevy of challenging suggestions. Public interest in nutrition is high. Congressional interest is widely publicized. And the key government agencies are making progress in involving consumers, in developing understandable materials, and in evaluating research results. As in so many other fields, the more we learn, the more we realize we need to learn more and to translate that knowledge into practical advice.

CONGRESSIONAL PANEL

Panel leader:	Chris Hitt Subcommittee on Nutrition Senate Committee on Agriculture, Nutrition, and Forestry
Panelists:	David Blumenthal, M.D. Subcommittee on Health and Scientific Research Senate Commitee on Human Resources
	Richard N. Brandon, Ph.D. Senate Budget Committee
	Richard Woods Senate Labor-HEW Appropriations Subcommittee
	Joseph Crapa, Ph.D. House Agriculture Subcommittee on Domestic Marketing, Consumer Relations, and Nutrition

MR. HITT:

We are pleased that NIH decided to hold a conference of this kind. Most important, I think we have a mix of scientists, consumer representatives, and representatives from the various government agencies who have a direct concern in the nutrition research area. Finally, we have congressional staff who theoretically provide an interface between the public's interests and the interests of the various agencies and the scientists.

Communication is critical, and conferences of this kind begin to foster the kind of communication that we as staff people need in order to address nutrition research issues. It is especially important for us to talk with the scientists who are doing the research, and scientists need to convey the information that they develop in their research to the American public in a way that people can use it.

Our first panelist will be Dr. David Blumenthal, staff member for Senator Kennedy's Health Subcommittee.

DR. BLUMENTHAL:

I think you speak for all of us--as well as for Senator Kennedy--in talking about your pleasure at seeing a conference of this type held on a subject like nutrition, which has been the subject of so much scrutiny and so much debate recently, and in particular your remarks on the composition of the group here today and the group that is participating in this discussion.

I know that we on the Senate staffs, and I am sure that our bosses as well, are delighted when the scientific community and the many constituencies that consider it important and are involved in its activities come to us with proposals and with plans for addressing areas of public concern that either have been neglected in the past or are emerging with new significance because of new scientific possibilities. I am sure that, the more of these kinds of events you hold and the more often you can come up with recommendations for us, the more pleasant our jobs will be.

I know there has been a lot of talk during this conference about nutrition and its place in the Federal budget, and about the relative size of our investment in nutrition research--whether it is $50 million or $90 million or $70 million--and how you define it. I am not an expert on that topic, and, important as it is, I think that what I would like to do instead is to point out--from the perspective of my committee, which has jurisdiction over all the health research activities that take place within the Department of Health, Education, and Welfare--where nutrition fits in with the total panorama of research activities that our Federal Government supports. I also would like to point out that, if there are lessons to be learned from the question of how large our investment in nutrition research should be, those lessons are probably applicable to multiple other areas as well.

The amount of money that is appropriately invested in nutrition, the subject of how to nurture a potentially or a documentably underdeveloped research area, is one that applies to multiple areas of research in the Federal budget. Many of you would differ, I think, about what those areas of research are, but I am sure you will all admit they are there, and I think the question is, "How did that come to be, and what can we do about it?"

It also speaks to the general issue of priorities within research budgets and how they should be established. Senator Kennedy has been chairing hearings for the past year or so, in which that has been a central theme. We haven't come up with any easy answers, but we have identified a number of contributing factors that we think have to be part of the priority setting process. We think the public has a major role in setting those priorities. We think the scientific opportunities in a particular area have a major role, and we think that the burden of illness associated with a research agenda or research area has a major role as well.

We know these three factors are important, but we are looking for guidance on how to put them together and how to systematically set up mechanisms to plan research investments. I was pleased to hear Secretary Califano address that issue a couple of months ago in a speech to the American Federation of Clinical Research.

Research planning and research priorities in pursuit of neglected areas are all very much on our minds. We are very concerned that mechanisms be put in place that can regularly review what the biomedical research community and other research communities are doing and that can pinpoint those areas we should be concerned about and focusing on.

I also think that, from this point of view, in nutrition as in many other areas--such as epidemiology, environmental health sciences, and occupational health sciences--we face the question of how to build a functioning and mature research area: a research area that really has inadequate personnel, that has had inadequate investment, that is of low standing in many scientific communities--even though it almost certainly doesn't deserve that low standing. From my own medical school experience, I can attest to the fact that the area of nutrition was virtually totally neglected, so it is very hard to look to the current generation of graduates of medical schools for a major interest in nutrition.

The question of how to rehabilitate an area of investigation is a critical problem that all of you may be able to help us with, and is one which certainly has broad implications for research policy.

We are looking forward to your recommendations for how to proceed in the nutrition area within the National Institutes of Health. I am certain that Senator Kennedy will pay the closest attention to them, and I am looking forward to seeing those results myself.

DR. BRANDON:

I want to talk about the overall structure of funding in nutrition and about nutritional status monitoring, which is the area that I have most recently been involved in. The reason I want to talk about the structure is to show how I got into it and where I think it is going. The questions you hear most often about nutrition around Congress right now are, "How do we structure nutrition policy, and how do we structure nutrition research policy? How do all these pieces of programs, that all different kinds of people are pushing, fit together?"

I don't think there is anyone who doesn't agree that nutrition is a good thing. There is a lot of skepticism, and a lot of concern about overselling, and where we are going with it all. I work for a Senator, Lawton Chiles, who is on both the Budget Committee and the Appropriations Committee. On the Budget Committee, we have the role of looking at the overall levels of spending for major missions of Federal programs. On Appropriations we go through the detailed line items into each institute of NIH, into each research program, and into the Department of Agriculture, and try to sort out all the individual pieces.

It is in those kinds of situations that you feel the very definite lack of structure that we have right now. We first became involved in nutrition policy, looking at it from the Budget Committee point of view on major spending, back in 1975, when the Food Stamp Reform bill was just getting underway. We started asking very simple questions, such as, "If only 37 percent of the potentially eligible food stamp population is receiving food stamps, are they the most needy 37 percent? Who are we missing in the other 63 percent? What do we know about where malnutrition is--where nutrition problems are and what they are? How are we targeting our outreach for this $9 billion worth of loosely defined nutrition intervention programs?

The answer we got was, "We have no system for targeting our efforts." We have a couple of broad surveys, like the Health and Nutrition Examination Survey, with far too thin a sample to do any kind of geographic sorting. It provides just the most rudimentary data on high-risk populations, and certainly nothing tying an analysis of high-risk populations in either a demographic or a geographic sense to clear data on nutritional intake and on health outcomes.

What we began doing was trying to say, "Can we begin structuring some way to feed nutrition research knowledge into ongoing intervention policy, both to evaluate what we are getting and where we are going with the $9 billion worth of nutrition intervention programs, and also to start improving those and to get some kind of idea of priorities?" Where we went with this was language in both the Farm Bill of 1977 and in the Senate report on the Labor-HEW Appropriations Subcommittee in 1978. These came out nearly simultaneously and instructed both the Department of Agriculture and HEW to develop and submit to Congress a joint proposal for nutritional status monitoring.

I emphasize the two bills and the two places and the joint requirement so I may underline what Hale Champion mentioned earlier: "You know you have hit an important issue in Washington when everybody is fighting over turf." But people in Congress, particularly Senators who serve on several committees, do have the luxury of sitting back from departmental rivalries and not having to worry very much about where the bureaucratic lines are drawn. What they want to see is that the job gets done, and they are willing to work together. The members of this panel have at various times worked together to try to get the different parts of the different departments who are involved in nutrition working together.

I want to outline just briefly what we required in the Nutritional Status Monitoring System proposal, which has, after many months, finally been submitted to Congress. I am sure copies will be available to anyone who wants to contact either me or HEW or the Department of Agriculture. We are going to start taking action this week in the Appropriations Committee. Some of the money is already in. There has to be a lot more development and a lot more input as to where the proposal goes.

To start developing a creative way to use data from both research and service programs, we divided the monitoring system into three major areas. We said first that we want an assessment system with periodic surveys and continuing monitoring of the general population. This will let us begin keeping on a regular basis some kind of count of the level of nutritional status in the United States, so we can provide the underpinning of data for epidemiological research in the population sense. We can then begin to know how we can target nutrition intervention to high-risk groups.

Second, we said we want a surveillance system. We want to identify remediable nutrition-related health risks to individuals or areas. We want to do this within a system that is tied to delivery mechanisms, not just on a very thin population sample, but on service programs like the maternal and child health clinics. Thus persons with nutrition-related health problems can receive treatment, and information can be fed back to the statistical system. This obviously involves an expansion of what CDC is already doing in this area, but it also involves making a little more creative use of service statistics. For you researchers, this is something Congress is very concerned about. We know we collect a vast amount of statistics routinely from service programs. Medicaid's Early and Periodic Screening, Diagnosis and Treatment program collects hematocrits on about 2 million children a year. That is 100 times the sample size of HANES. There is no systematic way to feed such information into our data systems for analysis. We are screening several hundred thousand more children in child health clinics, and we are not making any use of the data in a research sense.

Third, we want to see a systematic strategy for program evaluation for all the nutrition intervention programs, including both feeding and nutrition education. An interesting piece that came back to us, which we hadn't contemplated but which we think is very interesting, is for the FDA to conduct an evaluation of its regulatory and fortification programs.

We know that all these things will take time, but I think there is beginning to be an awareness in Congress that we have to develop information over a long period of time if we are going to ever really know what we are getting from those programs. The Departments have responded to this requirement and have submitted a proposal. The proposal is better in some areas than in others, obviously, and we are going to work with them to try to get it improved.

I think the bottom line of this whole discussion is that we have tried to take an approach to looking at the existing surveys and the existing needs, to move from simply statistical surveys and very narrow biomedical research into specific linkages between nutrition and health, and to develop a research strategy that ties to the overall framework of Federal nutrition policy. What we are still looking for, particularly from NIH, is for the research community to say to Congress, "These are the areas of basic knowledge that we have and ought to be applied, and here is what we need in applied research to do something with it; here are the areas of basic fundamental knowledge, either in the dietary side, the metabolic side, or the health outcome side; this is what we need to know."

I think there is a lot of concern about overselling minimal knowledge. Nobody in Congress wants to wait and sit on the limited knowledge that we have, but I think over a 5- or 10-year period, everybody in the game is going to be much better off if, at this very critical stage when there is much enthusiasm for a big takeoff in nutrition research, we really come clean and say, "This is what we know, this is what we don't know, and here is how we are going to go about it."

MR. WOODS:

I can't speak from the vantage point of a committee because I work for a Senator, Henry Bellmon, in a variety of areas concerning issues that bring me into contact with various committee groups, including Budget and Appropriations. I will therefore have to give you a rather disjointed series of observations that reflect the kind of thing that staff members who work in nutrition are apt to be thinking about these days, and I hope that you can put them together in some coherent fashion.

It has seemed to a great many of us that the NIH lack of emphasis on nutrition and other preventive approaches hasn't substantially altered. Perhaps we are wrong, but in the future I think we are going to need some substantive indications of progress, as well as new budget requests.

This may be tied into another situation that exists, I believe, on the Hill. As far as congressional oversight is concerned, in matters of research in particular, it has not always been successful. Sometimes it has not even been functional. I am inclined to think that Senate staff members in particular, perhaps those in the House as well, who are concerned with nutrition and health and related research, are going to have to organize themselves to meet periodically in between the budget and appropriations cycles to keep a kind of running tally on what is going on in various programs, so that when it comes time to make the kind of recommendations and offer the sort of advice we give to our principals, we will be able to do so with some modicum of competence.

Another topic: Proposition 13 is a many-splendored thing. It means different things to different people, and the subject is one afforded considerable analysis these days. On the one hand, it could mean that only programs without vocal, organized constituents will be substantially affected, assuming that the mood underlying Proposition 13 is widespread and sustained. On the other hand, it could mean that those programs with very little evidence of success will be most vulnerable. I don't know where that leaves the health research establishment, but I think it is fair to say that my Senator fervently hopes that the nutrition and prevention focus forms quickly.

It seems there has been a lot of talk in various government programs about health promotion and disease prevention. Here again, I think there will be increasing efforts to match accomplishments with stated intentions, to take a comparative look at performance versus goals.

A particular concern to us has been the lack of medical school nutrition education, which remains a problem. Most Americans, I think, still regard their personal physician as the best source of information about health and dieting, but they aren't apt to get much help concerning nutrition from him. If we are unsuccessful in influencing medical schools to change the training of physicians, I suspect that we will not make much progress in nutrition in the health sciences.

I am told by one Budget Committee health expert that in 1976 physicians prescribed $8 billion in amphetamines, much of it for diet purposes. There is some hope for improvement here. The Senate Labor-HEW Appropriations Report is expected to contain language mandating a substantial amount for nutrition education for health professionals, and we are going to follow up on that with Senators Magnuson, Leahy, and Schweicker in further contact with the agency concerned, to see if we can't get some immediate action for those medical schools that have expressed interest in initiating such programs.

Two rather parochial observations: In Oklahoma recently, we had hearings of the Subcommittee on Nutrition, and Senators Leahy and Bellmon were told by Dr. Esther Winterfeldt, who is a nutritionist and the President-Elect of the American Dietetic Association, that one Oklahoma State University study found there were as many as 20 different drugs and medicines being given to nursing home residents in five Oklahoma nursing homes, with almost no monitoring of drug interactions with each other and with diet. This sort of evidence of inadequate attention to the dietary situation of a very specialized population is something that bothers us a great deal.

A constituent problem that may be related to your work in some ways: We are in a period of rapid change in terms of research, and if we are successful in funding more research on nutrition, I would expect that we will have a good deal more in the way of reported study results that will change the state of knowledge about nutrition. This raises some difficulties for ordinary citizens. One long-term goal might be to create some clearly identified source of the best available information on diet and nutrition at a given point in time, some source that would give a clear state-of-the-art judgment, subject to revision as new research results become available.

As it is now, there are conflicting claims and partial bits of evidence that are reported in the public press. People become very concerned about what is safe to eat and what is not, and what has an effect upon them personally and what does not. I think there is a great deal of frustration and disaffection about this entire process. I don't know if we can fashion some institutional way to handle that, but I think it is important.

DR. CRAPA:

I think I am in the unusual position as a staff person from the House in saying that this time the House concurs very much with the Senate on those opinions.

Kurt Vonnegut, an American writer who was a medical student at one time in his career, wrote a book called God Bless You, Mr. Rosewater. Mr. Rosewater was the multimillionaire funder of a foundation that had many noble causes. One night he had to give a speech before a group of science fiction writers, and as he looked over the speech the next morning, he noted that he had said, "I love you S.O.B.'s. You are the only ones who are honest enough to tell us where we are going." I certainly want to extend to you the respect that we have for the research that you are doing.

I am not a nutritionist, so I come here today something like Nathaniel Hawthorne who, when he attended formal meetings in the 19th century, said he always looked like a criminal at a detectives' convention. I come fully aware that I am not speaking to you today as a nutritionist. I really would rather not talk about the science of nutrition, but about the politics of nutrition.

Nutrition and its corollaries, nutrition research and nutrition education, are becoming popular if not exotic terms in Washington political circles. Our own subcommittee, which is relatively new, began its work in nutrition last year when Congressman Richmond (with his own very deep interest in this area) became chairman. Our members have concentrated on nutrition education, but in doing so we have become aware of its important connection with your own activities. That connection between the research community and the educational community needs to be enforced and strengthened.

According to a recent survey conducted by Woman's Day, 77 percent of American consumers questioned said they were seriously concerned about nutrition. Who can be against nutrition? Certainly not the press; surely not the medical profession or the food industry; definitely not the Government.

Each in turn is doing its best in splendid isolation to foster an information overload that is causing considerable confusion among consumers. Nutrition columns in local newspapers are read with the avidity once reserved for advice to the lovelorn. Each week, publications like the National Enquirer are outdoing themselves with bold headlines proclaiming such discoveries as "a simple addition to your diet can cut cancer 80 to 90 percent."

America's long romance with the dinner table as the best-fed nation on earth has paid off--for publishers of magazines and diet books. Advising people on how to lose weight is now a $10-billion-a-year industry. The proliferation of rice, protein, and carbohydrate diets and the new generation of Adelle Davises and Carlton Fredericks lends particular credence to Ron Deutsch's caveat about nuts among the berries.

With uncharacteristic appropriateness of title--and today we have heard a great deal about what the Federal Government could do to bring nutrition information to the public--the General Accounting Office recently published a study titled "Informing the Public About Nutrition: Federal Agencies Should Do Better." What shocked us most in this report, which was requested by our Subcommittee, was to learn that USDA's extension food and nutrition program reaches only 2 percent of its intended audience, and the EFNP program only 20 percent.

The figures for HEW are equally shocking. Headstart reaches only 15 percent; the elderly nutrition program, only 23 percent; and the consumer adult education program, a scant 2 percent.

Clearly, our efforts must be guided by a policy that coordinates responsibilities and activities and holds government programs accountable for their effectiveness. The old nutrition education of simplistic slogans, vintage depression pamphlets, outmoded strategies, and insufficient programs must be replaced with the new nutrition education that is diet and health oriented, that is based on objective and current scientific information. I don't think consumers want a graduate education in nutrition--the syndrome that they must know the full detail. Consumers are at various levels of awareness. There are different segments of the population that want different pieces of information. But I think it is important to make available to consumers the best unbiased information that is available.

Nutrition research itself has become the subject of a whole series of studies: from the Office of Management and Budget (OMB), the Office of Science and Technology Policy (OSTP), the General Accounting Office (GAO), and the Office of Technology Assessment (OTA). According to the OSTP, there are four areas of nutrition research that need further funding: the relation of diet to disease, food composition and safety, nutrition education, and surveillance and evaluation.

The OTA will soon be releasing its report recommending a radical reorganization of human nutrition research priorities. In addition to calling for a sizeable increase of the research budget, the authors of the report, I understand, will stress the need for transmitting this research into public information about diet and health. If, as research scientists, you wish to benefit from this funding, you must be willing to demonstrate the connection between the laboratory, the university classroom, and public policy.

New funds will be allotted only if a case for public benefit is made. Politicians are fond of quoting the escalating costs of our health care system and will only condone current research expenses or additional expenses if they can be convinced that the fruit of this research will utlimately lower or restrain these phenomenal costs. It may perhaps be somewhat ignominious to have to go through this kind of justification to those with the power of the purse. They are not scientists, but they do respond to things like Proposition 13. The people have spoken with Proposition 13; we are not sure what they have said, and I am not completely sure anyone is at this point, but the bandwagon has begun to roll, and so we face arbitrary budget cutbacks. Unfortunately, the kind of funds that are most vulnerable are research funds. I think there is such a thing called the Proxmire Principle, and it is very easy to cut back on or to attack research.

The nutrition science community has not always made a clear case, I think, before the committees of Congress of what its research priorities should be, what kind of research it needs to conduct, and the kind of financial assistance that it needs to accomplish these things. Too often I think, the Congress sees scientists placed in the false position of squabbling with one another over specific points of a legitimate debate. Members of Congress perhaps incorrectly conclude that two nutrition scientists cannot agree on any single point. That is certainly unfair, but it is a perception that is nevertheless widely held.

I will not presume to lecture you on the need to tie research to preventative medicine from curative medicine. This is currently a matter of some interest to the Congress. Members are concerned about the relation of disease to diet and health. There is more work to be done, as Senator McGovern has stressed, in cancer and nutrition research. I make a point that the digestive disease issue needs to be further examined. Twenty-two million people in the United States now suffer from digestive diseases. One out of three beds in our hospitals are occupied by people who are suffering from digestive diseases. We need to know more about the relation of nutrition in this area.

Obesity is another problem. As I understand it, 20 percent of our population are obese, 40 percent are overweight, and about 1/3 of our children are showing symptoms of overweight. What are the health effects of obesity? What is the relation of diet and health in this area?

More fundamental research needs to be done on consumption patterns, on eating behavior, and on successful intervention to change unhealthy eating behavior. I think all these areas need to be looked at to establish a continuum of nutrition research. This also means cooperation between HEW and USDA. The job is large enough beyond imagination for the two departments. It is a great risk, from what our Subcommittee has seen, to split these functions. Any medical findings that you have in the laboratory will impact on the food supply and will impact on our knowledge about food. I would hope that those connections are maintained.

MR. HITT:

I have been on the Hill about 2 years now, and Dr. Blumenthal came not long after I did. He and I have been wrestling with the question of biomedical research. For example, one of my first assignments when I joined the Select Committee was to develop a major bill on prevention. So I met with a number of people in the biomedical research community, including many of the Institute Directors at NIH. As my bill was rolling along, and we were working it forward to a point where we could introduce it, a friend of mine said facetiously, "Maybe you ought to retitle the National Institutes of Health as the National Institutes of Disease. At least we would be telling it like it is for the most part."

In that vein, I have a number of points that I would like to raise, based on what I have heard during the 2 days of this conference. Although it is my perspective alone, the following points represent what I think are the feelings of the consuming public, as well as parts of what each of my colleagues on the panel has said to you.

First, I would just like to ask some questions. How many people in this audience today actually work here at NIH? Just raise your hands. I hope every Institute is represented. I don't know that for sure, but I would hope that is the case.

How many people here are simply interested consumers who wanted to come to see what the projections for nutrition research in the '80s are? Well, that is good. We have a few.

How many people are here from the press? Three or four.

Finally, I want to ask how many people here consider themselves either nutrition scientists first, or nutritionists first, as opposed to something else? Well, that is a very healthy number.

The reason I asked that last question is the following: We had a hearing just last week in which cancer was the predominant topic, but also in which we were looking at all of nutrition research at NIH. One of the objectives we were trying to convey at that hearing, which I think because of the over-emphasis on cancer we didn't quite get across, is that at least at the Nutrition Subcommittee, with whom I work, we are concerned about what I would call the mindset, the perspective, with respect to research and how we approach research at NIH.

I have had many long discussions with a number of people, including Dr. Simopoulos, the Vice Chairman of the NIH Nutrition Coordinating Committee, about whether it is important if an individual thinks he is a nutritionist first and a cardiologist second, as opposed to a cardiologist first and a nutritionist second. I think it is very important, and I think consumers think it is very important, and I think it has a lot to do with how people address research problems.

Similarly, I think that what we have seen in the '70s is a growing concern about how we are investing our dollars in research and what the clues and signs are for how we set the priorities for research. Because of this, I think epidemiology is being given more and more credence as a signpost, as an indication of those areas of research that may show higher probability of return for our money, and that it should be given a better balance with the clinical and basic research that has always been important at NIH.

Within priority setting, I think the consumer panel said it quite clearly. Scientists do not have the sole prerogative of what the research priorities are in this country. Clearly, within the priorities as perceived by all of us, scientists can tell us what is do-able research, what are solvable problems and what are not, but they don't have the sole decision-making power to decide where the money will be spent, and on what.

In that respect, as I mentioned earlier, last week we had cancer hearings because our committee is very concerned that a significant majority, as high as 50 percent depending on who you talk to, of cancers are diet related, and yet somewhere between 1 and 2 percent of the cancer research budget goes into the diet/cancer research question.

As has been said on the news a number of times the last week, because evidently a lot of people decided this was of interest, the Congress has a right to ask these questions; I think they are asking more and more what the priorities are. The fact of the matter is that when we decided to increase the budget for cancer research in 1970-71, no one looked at the priorities within the cancer research establishment. We simply decided that cancer would become a national priority.

I don't think anyone questions that this complex of dread diseases is of major concern, but at the same time I think that we have to look at the priorities; we have to see where we have been moving. For some people who worked very hard to get the "war on cancer," as some people call it, moving forward, I don't think hearings like last week were a disservice. I think it is part of the congressional process, and the fact that they were held would indicate that there must be something wrong with the priorities that are currently being used at the NCI now, and possibly that reflects a concern, as I will point out, with respect to priorities within all of NIH.

Related to this same question, of course, is cure versus prevention--where is the emphasis going to be? I would like to read two quotes from Senator Bellmon's speech at this conference. He said, "As more and more exotic and technical methods of treatment are developed which impact on fewer and fewer clinical patients with acute or chronic conditions, the cost of medical care rises without beneficial impact on the lives of the majority of Americans." He also said, "When science policymakers shortchange applied research and fail to diversify the basic research effort, they act as if it makes no difference what is important to the society which supports their efforts."

In that latter respect, I think conveying findings is important. Dr. Gaull pointed out that he felt maybe it wasn't NIH's responsibility. There are some people who would say that, if NIH gives up the responsibility, then the biomedical research community is going to be in a lot of trouble because they are not going to have any access to the public. However, if that is what NIH or the Congress chooses to do, it still is your responsibility as scientists to ensure that the goverment agency with responsibility for disseminating the information does its job. People want to know what you are spending money on and what the results are.

So, whether you do it or somebody else does it, somebody should take responsibility for conveying research findings to the public.

With respect to basic research, we are going to continue, I am sure, to fight over how much money is spent on nutrition research. For FY '77, we have had numbers from $80 million to $94 million based on NIH's efforts to date, which I compliment them on. I think their information retrieval system is critically important. For the first time, NIH can actually tell us on what they are spending their money with respect to nutrition research. In the past, it was always estimates.

I know that Rick Brandon in the budget process is very interested in the retrieval system, because it helps him figure our budget mission priorities within the Congress. I also would say that the definition that has been provided to come up with the $94 million figure is all encompassing. Now, by making it all encompassing, it includes basic research and everything else. The Congress has no problem with basic research. In fact, there are staunch supporters. Senator Eagleton is one who is very well known for supporting and maintaining a viable basic research effort. I believe that somewhere between 30 and 35 percent of the NIH budget goes into basic research. With those figures, about $50 million of the $94 million nutrition budget is basic research, which would suggest that about 5 percent of the basic research budget at NIH goes to nutrition. This is encouraging, because it is higher than the 3 percent for all of nutrition research at NIH.

What I am trying to get at is that, from a congressional perspective, we don't handle double counting very well. My understanding, and I have talked to a number of people in the research community, is that basic research is simply basic research--you do basic research because you hope it is going to have applications in any of a number of areas, but that basic research is not solely nutrition or anything else. It could be endocrinology, it could be cardiology, it could be oncology, it could be any number of things, and once you get outside the basic research area, you get into the issue of whether the funding for a particular grant is primarily because there is a nutrition application or because it is something else such as cardiology with a nutrition application.

These are all things that we need to talk about and that the Congress has to get a better grip on. But what I am saying is that currently there is a large gap between what we believe is being spent on nutrition research and what NIH is telling us that they believe is being spent.

Finally, we get to the conference itself. Six scientific panels have discussed a number of issues. These discussions showed where we have been. We talked about research in the '40s, in the '50s, in the '60s, and even some in the '70s. The genetics panel was a very good example of that. Quite simply, no one questions the importance of genetics, but if you look to the topics that were discussed, the galactosemia and lactose intolerance research was done in the '50s, here at NIH. There was discussion of familial hypertension, which was the most recent and very encouraging. I think it is giving us some directions in the heart disease area. But essentially we were talking about old material.

The pregnancy question, I think, is very important. What is ironic is that we seem to be going to put a lot of emphasis on pregnancy and early child development so that these people can grow up and die at an earlier age of cancer or heart disease or whatever because we don't seem to be particularly concerned with nutrition research on those major chronic degenerative diseases.

At the same time, I felt it was very good that we had a basic biochemistry panel. I think the work on the vitamin D metabolites was fascinating, but again it was an indication that we first discovered that in some way vitamin D was related to the problem of rickets, and we began to prevent that problem. Only in recent times, through the ability to fund basic research, did we discover the vitamin D metabolite and all the biochemistry that goes with it.

Finally, in the behavior area, which everyone thinks is a priority, it appeared that we still are pretty much in the dark. As one of the scientists said, "We know what people don't like, but we don't know why they eat what they do like."

This brings me to my question: "Where is the vision and creativity that in the past has been synonymous with NIH?" This conference is called "The Biomedical and Behavioral Basis of Clinical Nutrition: A Projection for the 1980s." I think most people would say that very few things have been said that would really give us an indication of where NIH is moving, and from a congressional perspective that is critical. I felt this morning that Dr. Cutler did a very good job of trying to give us an overview of where USDA is heading, but I am not clear at this point that anyone on the Hill has a good idea of what NIH plans to do in the '80s.

In particular, in the last year three major reports have come out--one by the Office of Technology Assessment, one by the General Accounting Office, and one by the Office of Science and Technology Policy--all looking at the question of human nutrition research. The latter report had participation from USDA and HEW. I think that the existence of the reports alone suggests that NIH isn't doing its job. If we were doing what we should be doing in nutrition research, no one would have felt that it was a high enough priority to invest the time of three different groups in investigating what the research gaps are in human nutrition.

If you look deeper, I think that what is somewhat astonishing, and some people might say appalling, is that, in the one report where the two departments had the most input, USDA seemed to hold up their end--human requirements, food composition, behavior, etc. In the OSTP report, the emphasis that was given for NIH research was on things such as iron deficiency anemia and obesity. There is no question that finally obesity is getting the attention it deserves, but I don't think iron deficiency anemia begins to compare to 50-percent mortality from heart and other cardiovascular diseases and 17-percent mortality from cancer. I think that somebody has a skewed priority, and the American people seem to think so, too.

One of the encouraging things that did come out yesterday, as I said, was the familial hypertension genetics research. That is very encouraging, and I think it is going to be very useful. I think the issue of taurine in breast milk is very encouraging.

I think Dr. Wurtman's work, which he himself said no one would have thought would be a topic in a nutrition research conference, was also very heartening.

Finally, I think Dr. Dubos' statement that taller Japanese will not necessarily be healthier or live longer is another way of saying that maybe bigger isn't better. I know that I hear many people tell us we have the best diet in the world, and if we look at the American people they have the greatest stature, etc., but no one seems to be wondering whether these are necessarily an indication of the healthiest people.

With respect to the NIH activities cited by Dr. Simopoulos, they propose to have a conference on hyperalimentation, which is a controversial area. I applaud them on that. I think, though, that we found last week that at the same time we have an urgent problem right here at the finest clinical center in the world. We have a cancer patient population who is severely undernourished, even though there is a hyperalimentation system. I know that there are respected people in the research community who have spoken out on this point, including at our hearings.

I would suggest that there is a very good possibility that if we get any more information, there will have to be an audit.

Another thing which I think is again encouraging is that there is going to be an obesity conference. It has to do with technology transfer for morbid obesity. But what I am concerned about, and we have had the issue raised this morning about coronary bypass surgery, is whether this is going to become similar to coronary bypass surgery. There have been 25,000 operations for morbid obesity; I hope I am wrong but my understanding is that NIH has never funded a grant to study this, and yet we are going to have a technology transfer conference on it.

Most encouraging is the fact that there seems to be an indication of the desire to develop some clinical centers. I know many researchers who have spoken in support of these centers. One of the things that again I felt was astonishing is that of the 60-plus centers within the NCI, there is not a single one that specializes in nutrition.

This conference is supposed to cover projections for the '80s. There are three things that come to mind if we are going to talk about what we are going to do in the '80s. First, when are you going to get these clinical nutrition centers going and how many of them are there going to be? Where is the substance behind this proposal? Second, we talked about the 205 people receiving nutrition training currently at the NIH. As we all know, and as we pointed out at the cancer research hearing, when funding increased for grants in immunology research, the number of immunologists in this country doubled in the 6-year period. Nutrition has not had that kind of increase, and it is because we are not putting money into it. In the same vein, if we are going to put money into grants, we need to put money into training.

Finally, and this is what is most appalling, and I have yet to see any projections, we are having a conference on nutrition at NIH in the '80s, and no one mentioned whether there is going to be a budget increase. What are the projections? Where are the Institutes going to move on this issue? I would have thought that Dr. Fredrickson at some point would have talked definitively about an increase in the budget. If there is not going to be an increase, then there had better be some good explanations of why there is not.

A PROJECTION FOR THE 1980s

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Panelists (cont'd):	Gilbert S. Omenn, Ph.D. Assistant Director Human Resources and Social and Economic Services Office of Science and Technology Policy
	Chris Hitt Subcommittee on Nutrition Senate Committee on Agriculture, Nutrition, and Forestry

DR. HIRSCH:

This panel is entitled "A Projection for the 1980s." We have a most important charge.

I would like to take the Chairman's prerogative to begin by talking with you for just a few moments--partly in answer to what some of the previous panels have brought up, partly to express my own feelings about what this conference is about and where biomedical nutrition is going in the '80s, but perhaps mostly to set the stage for my other panelists who will undoubtedly use my remarks as a sounding board for making definitive and specific remarks.

I believe that not since Ponce de Leon set his foot ashore has there been such an interest in finding some magic mixture of foods or fluids to put into us that will assure eternal life, health, and happiness. It has been suggested that perhaps the magic mixture is at hand but is immured within the walls of NIH or other scientific institutions, and that a little more research translation might make it available to all.

I can assure you that such is not the case, and I am sure you know this is true also. There is a vast amount of information that has yet to be acquired for each of the nutritional steps to be made in creating more health and less disease. This is not to say that nutrition education and research translation are not of great importance, but the single big stumbling block is new information. Indeed, biomedical scientists have an extraordinary reputation for being very communicative about their findings and for making new discoveries readily available to the public.

The question also has been asked, "Where has NIH been?" We can summarize where NIH has been, not just in the '50s and '60s, but in the '70s as well. NIH has been continuing what might be called classical nutrition research. This is of ongoing importance and will continue to be important into the 1980s. Examples are the role and need for very specific nutrients, whether carnosine or taurine or copper. The intricate biochemical mechanisms whereby vitamin D is rendered active and performs its central function have been elaborated; this is ongoing research funded by NIH. All the findings of these classical nutritional studies can be enormously important, as indeed they have been already, in the alleviation of human suffering.

Another note, I think, has also been sounded at this meeting, and I would like to believe that this new note is a special frontier and a new responsibility for clinical nutrition and for the NIH.

We were told a good bit about the genetic diversity that exists in all of us and its special meaning for nutrition. We also all have a common, very important genetic endowment that reflects our nutritional past history as a species. We have an incredible ability to seek out and store calories, and it is only in this century that we have been given the opportunity to fulfill this genetic endowment. Consequently, there is a high incidence of obesity. One of the important reasons that this comes about is not because of a lack of nutrition education, but because of the fact that man is an organism who at birth or very shortly thereafter seeks sweet and salt tastes, a phenomenon shared by all of us.

I can assure you from my own experiences in the treatment of obesity that the vast majority of cases of obesity cannot be made to disappear with any kind of education program. What is needed is more information about the mechanisms of obesity and very possibly the prevention of obesity by appropriate nutrition programs in the early years--but not more education of the obese.

I am pleased to announce that the NIH has been a supporter of the psychophysics of taste in the newborn. I don't know of other Government agencies doing this. Without information about the psychophysics of taste in the newborn and how taste develops throughout childhood, the likelihood is great that every kind of nutrition education program will be bucking against the fact that children like sweet tastes.

We have heard a great deal about the forces at work in intrauterine life and the earliest days after birth, and indeed these are times of special plasticity of the organism. It is as though we have some final chance to modify cellularity or biochemical pathways, a chance that becomes increasingly elusive as we grow older. This has been known from time immemorial, but the biologic substrate, the counting of the cells, and the demonstration of the biochemical pathways that can be altered are discoveries that have been made only in the past decade or two by dint of very careful clinical and basic investigations.

In all these considerations, the choices about nutrition relate not so much to what diet is best, but what diet is best for what type of person and what kind of life.

Clinical nutrition can provide the wherewithal for aid in combatting infections, for better performance, and perhaps for enhanced longevity, but a main aspect of clinical nutrition is to consider diet as a major component of our environment that can make us different in size, in disease patterns, in length of life, and in the way we feel. We have all heard of the possibility of genetic engineering, the hope of this, and perhaps even the fear of it. Nutritional engineering is upon us, and our current disease patterns and current problems of health relate very much to the fact that we have been the subjects of considerable nutrition engineering in the 20th century. It has made us have much less vitamin deficiency and much less overt nutritional disorder, but of course we have paid the price in the prevalence of other disorders.

The frontier of clinical nutrition for the 1980s, as I see it, is the clear delineation of the effects of diet, not in arriving at a single optimum diet or a single technique for educating the public in a particular diet, but rather diet in changing the *kind* of people we are. Clearly, this has to be something that the political process, the consumer, everyone is involved in. It cannot be a scientific decision alone.

A certain diet may lower serum cholesterol, but we have heard it may also so alter hepatic mixed oxidase functions as to render precarcinogens more readily carcinogenic. Better nutrition for infants, in terms of increased intake, may make for more intelligent human beings with fewer infections, but perhaps with more obesity and premature death from degenerative diseases.

These are extraordinarily subtle problems, not only politically or socially, but scientifically as well. Many of these problems will require very long prospective studies, both in man and animals. We are talking about so shifting our environment as to make a major impact on health and disease. We must be careful to have the facts at hand before we take any new steps.

These are the choices we will have to be making. Unfortunately, we have made them to date with very little understanding. We have a special role to understand these adaptations and alterations in far greater detail than we now do, so the choices are not quite so Draconian. They are not necessarily choices among bad things, but clearly some are better than others.

This to me is the clinical nutrition of the 1980s and an overview of the special role that NIH has to play. It *is* the National Institutes of Health and certainly not the National Institutes of Disease if it continues to pursue these investigations. All the things we have talked about have social, political, and anthropologic dimensions, but the roots of clinical nutrition are extraordinarily deeply placed in a *cluster* of sciences, particularly metabolism, biochemistry, and endocrinology. More recently, neurobiology and physiological psychology have come to join this cluster. It is impossible to have heard the papers presented at this conference without believing that this cluster of sciences *is* involved.

There are many more facts to be learned, and what we learn must be presented by the scientific community unambiguously so that the facts can enter into the process of decision-making. I do not believe that every scientist is as talented as another in doing this, nor that every laboratory at NIH is as good at doing it as another. We have to specialize. We have to develop special techniques whereby the scientific community arrives at its consensus and whereby NIH makes this kind of presentation. The final choices must be public decisions.

The problems that face us are so vast that there is clearly work for every Federal agency and for integrated effort on the part of all. In the scientific community, there is a crying need for a new type of clinical nutritionist, different from anyone we have seen in the past, someone very well grounded in the basic sciences and in clinical matters, but applying himself to these newly formulated problems of clinical nutrition.

The biomedical scientist, we should not forget, was a creation of the 1950s and the 1960s, and the NIH was the midwife at the birth of the physician-biomedical scientist in this country. If NIH had done nothing else in all these years, this creation alone would have been a massive achievement. NIH now has a special role to play in supporting the birth of a new kind of special physician or paramedical clinical nutritionist.

Where perhaps NIH can be faulted is by responding to some of the burning nutritional issues of the day and to the requests of other agencies by presenting only budgets or accounts. I know now that there is a strong move afoot within NIH to respond by making a projection for the future in terms of the problems and the approaches to answering these problems, and this is exactly why this particular conference was held.

DR. ISSELBACHER:

It is said that if everyone agrees with what you're doing, you have to ask yourself what's wrong. I was impressed by the criticism we have heard from some of the conference speakers, because I think constructive criticism is desirable. I view those of us here as a community--not in an adversary relationship--but as a community of scientists, the public, health-related scientists, biomedical scientists, social workers, nutritionists, people from all areas, having the same objectives. We may approach these objectives differently, and perhaps our priorities at times get distorted.

I am reminded of the comment made at my own institution, Massachusetts General Hospital, where we have a scientific advisory committee. A Nobel Laureate who is on that committee said, "You know, I've been on this committee for 3 years, and I'm really amazed. Why do you have it? Why do you want so much criticism?" We responded, "Because we think it's healthy." Rather than assuming that everything is alright, we need to get input to see where things can be improved.

I would hope to think that things may really not be as bad as they look. I really think, on the whole, that this nation, with the help of the NIH and Congress, has done a superb job.

Before making any additional remarks, I'd like to, in self defense, respond to the issue of why I brought up the discovery of galactosemia in my presentation in Panel I: "Genetic Disorders: Lessons for Clinical Nutrition." I did so, to some extent, because I worked on it, but really because, for me, it had a ripple effect. It was galactosemia that taught us about galactose and its effect on the brain. That led to the study of the effect of sugars, such as glucose and galactose, in causing cataracts, and research is now underway on the mechanism of cataract formation. There is a question of how cirrhosis is produced, and we have now learned that derivatives of galactose can produce cirrhosis. In my earlier presentation I used galactosemia as an example of the learning process and to demonstrate how scientific inquiry proceeds.

Going back to some of the points that have impressed me, as I look at the role of the biomedical scientist interacting with the public and with the Government, part of the problem is a tendency for us to respond by promising too much. I think that happened in the cancer area. We are all guilty of being led down the garden path and then falling into the trap of saying we can do more than we are able to do in too short a period of time. Scientific progress must be slow in order to be solid.

Second, I don't think the NIH can be all things to all people. I believe the agency is doing an effective job. I don't agree with the statement that the NIH should abdicate its role in information exchange or in informing the public. The NIH and we as scientists have a responsibility to inform and to educate, in the best way we can; we cannot say that it is not our business, that research is "our thing," that we should stay in our laboratories and let someone else do the commuunicating. If we don't communicate our findings, others may not do it as well, or perhaps they will say more than they should about the meaning and significance of a given discovery. The NIH and the scientists that it supports *do* have a responsibility, and they cannot and should not abrogate it. Communication is perhaps something we were not trained to do and that we can learn to do better, but I think that communication *by us* is essential.

In that regard, the question is, "How do you inform the public?" The public is amorphous. People differ in their backgrounds. I feel that the scientific community can communicate in a variety of ways. As physicians, we need to inform those with whom we interact, such as other health scientists. As was pointed out, physicians are not doing a good enough job, and in part that takes us back to the fact that medical schools are not doing a good enough job. And why is that? Because they haven't had enough Departments of Nutrition. Therefore, there are few who are championing nutrition as part of the educational process. The education of physicians is crucial; and then physicians, in a domino effect, will educate other health scientists and in turn the public.

I think there is a problem for us as scientists in communicating with the public at large, but I think we can communicate with Congress and with other colleagues and do it effectively.

A third concern I have is the constant allusion to the lack of applied research. One of our panelists stated earlier that much information was acquiring dust on the shelf. I personally wonder how valid that statement is. We don't have too many scientists who recognize the wisdom of an observation such as that mentioned earlier regarding the effect of choline on the brain, the effect of vitamin D hormone, and the role of taurine. Observations such as these are not sitting on a shelf waiting for someone to pick them up and apply them. True, there may be others that we're grappling with and do not know what to do about. Therefore, this "transferase deficiency," as one might refer to it, is not as big as some may think. There may be a spectrum of what Dr. Wurtman said about the use of choline for movement disorders versus choline for the healthy, average individual in this country. Perhaps we are talking about a spectrum of applied research--on the one hand as it may relate to a cure of a disease, and on the other hand as it may relate to health.

When we talk about nutrition and what to do about it, money is one thing, but, as others have pointed out, we need people! Research cannot take place without qualified scientists. Nutrition has not had the press and the scientific experts that it needs. Something needs to be done to attract investigators into this area, to give it "legitimacy" and a level of scientific expertise that will attract others so we can accomplish the goal for the '80s that we have set for ourselves.

Finally, as far as priorities are concerned, I wouldn't presume in this short a period of time to arrive at priorities that I would think were meaningful. While I think priorities are extremely important, I would hope that they could be developed in a setting with more reflection and deliberation.

We can ask many questions--why obesity, why malnutrition--but as scientists we have to ask questions that are "researchable" in the next 10 years. We need to deal with "the art of the soluble" rather than what at the moment may still be insoluble questions.

DR. AHRENS:

I have divided my remarks into what I would like to call scientific frontiers, as contrasted to organizational changes. We have been hearing from Dr. Hirsch and Dr. Isselbacher more about organizational matters than frontiers of science or frontiers of nutrition research. I would therefore like to say a few words about frontiers, especially in lipid research and coronary heart disease. What are the things that need doing? I have identified three major fronts that I believe need careful attention.

First, we have heard about the risk factors for coronary heart disease that were initially identified in the Framingham study and have been expanded by many others since that time. I would remind you that probably more than 50 percent of the coronary heart disease in this country occurs in people in whom there is a complete absence of the risk factors thus far identified. Therefore, it is clear that we need to have a much better idea of all the factors that cause individuals to have coronary heart disease.

The second point is that the known risk factors should be more sharply defined than they are at present. One good example of this is the current excitement over the old finding of the importance of what are now called high-density lipoproteins (known in the newspapers as good cholesterol as against bad cholesterol).

The story goes back to the early 1950s, when Barr and Eder showed that men and women have very different distributions of high- and low-density lipoproteins (at that time they were called alpha and beta lipoproteins). In the intervening 25 years we have gained a better understanding of the functions of those two major classes of lipoproteins, so that today there is some sense to the idea that high-density lipoproteins may be a protective factor, counterbalancing the harmful effects of low-density lipoproteins.

If future work bears out this concept, it seems clear to me that we need to know more about the effects of drugs and diets used for lipid-lowering, about the levels of high-density lipoprotein and its composition, and about the effects of weight reduction and exercise. We ought to be thinking also whether the protective factor results from the absolute levels of high-density lipoprotein, or from its relationship to the low-density lipoprotein fraction. Is it the ratio that counts, or is it the absolute level? That is simply not understood at the moment. Further, the work originated by John Gofman, and now carried forward by Frank Lindgren and Howard Eder, indicates that there are at least two high-density fractions, called HDL2 and HDL3; it is not yet clear whether these two subfractions are equally beneficial, or whether one remains constant while the other fluctuates.

My third point is the very practical one stemming from the Dietary Goals proposed by the Senate Select Committee. I would like to suggest that we determine whether the Rockefeller diet is any better or worse than what I must call the McGovern diet. The contrast is as follows. The McGovern diet is a low-fat diet with about equal proportions of polyunsaturated and saturated fatty acids, whereas the Rockefeller diet that we have been using for more than 25 years is a diet not low in fat but rich in polyunsaturates. Is one superior to the other in the long term in the prevention of coronary heart disease?

Researchers ought to be able in the near future to compare the relative merits or demerits of those two diets in all kinds of hyperlipidemic people and to do so in biochemical terms. We ought to learn the relative effects of the two diets on plasma lipid changes and on high- and low-density lipoproteins as well as on their turnovers. Since cholesterol is a major constituent of the bile, and since many of the modalities of treatment that are now used for the control of hypercholesterolemia have led to gallstone formation as a counterbenefit, we ought to inquire about the relative effects of those two diets on the composition of bile and biliary lipids. We ought also to inquire into the relative effects of these two diets on steroid hormone metabolism. And we ought to ask how the two diets affect membrane function, since cholesterol is a key component of all our membranes, and since the plasticity or fluidity of membranes is largely controlled by the degree of saturation and unsaturation of the dietary fat.

Those are at least three frontiers of science that I identify as being important. They have practical applications and yet are basic science questions.

I would now like to say a few words about organizational questions. First, I could not agree more with Dr. Hirsch and Dr. Isselbacher about the need for Clinical Nutrition Departments in our medical schools, and even in research institutions like Rockefeller University. The fact that in FY '77 the NIH supported only 205 trainees in nutrition, a large proportion of whom are postdoctoral, is pitiful. That is an incredibly small number of trainees for a subject of such great importance. I would second everything that has been said about the need for Departments of Clinical Nutrition.

Second, I disagree somewhat with Dr. Isselbacher about the role of NIH in information exchange. In my view, the NIH is not the best conduit for the transmission of research progress and science information to the general public. That is the obligation of individual scientists who must learn not only to communicate more clearly with each other but also with the public, especially through Congress. Scientists have not communicated to the extent that they should have in the last 20 years. Indeed, I contend that some of the quandary that science finds itself in today is due to the fact that we have failed to communicate to the Congress what we are up to, why progress in science is often so slow, and what the difficulties are. I would hope not only that scientists will offer their services to congressmen and senators, but that congressional aides would turn to us more often.

Third, the problems of nutrition are immense, and there is no reason why the problem areas **cannot** be divided among the various agencies of the

Government, all of which have a stake in the matter. Any territoriality problems can be settled by getting together and learning how to "cut the cake."

Fourth, it seems to me that there has been a growing tendency for the allocation of funds by the NIH to what have been referred to as agency-initiated projects. I am personally dismayed by this tendency. The best science is done when it is dreamed up and carried forward and fought for by the individual who dreamed it up. By the same token, more emphasis should be given in the future to projects generated in the scientific periphery--projects that are brought here for servicing by the NIH, rather than being generated, molded, and judged by the staffs of this organization. I would hate to think that in the future we are going to rely on administrator-prophets who draw up laundry lists of projects that seem important to them and to which the scientists on the outside respond because that is where the money is.

Finally, let me say how much I have enjoyed being included in this conference. It has opened my eyes to many things that I did not know existed. I have learned how nutrition matters are being evaluted by the various agencies of the Government, and more than ever I see the need for Clinical Nutrition Departments in our medical schools. Today's medical graduates are poorly informed about nutrition and are almost disinterested in it. For the time being, we must learn to rely more heavily on the help that trained nutritionists can offer to the medical profession and to patients. But if Clinical Nutrition Departments are put into effect, in 10 years we could feel some optimism over the possibility that doctors would become excellent informants about nutrition.

DR. FREINKEL:

I think the optimist feels that this is the best of all possible worlds, and the pessimist believes that it is true. After our last 2 days, one has the feeling that nutrition is perhaps somewhere in between those two extremes.

I do feel, however, that there are a few points that I would very much like to make. One of them is that the scientist really has no lobby. The scientist has no pressure group to represent him. Thus he is frequently cast in the position of justifying his raison d'etre and his modus operandi. I do think, though, that the scientist is extraorinarily responsive to that which he perceives or is communicated to him as the needs of society. In the delineation of those needs, it is very important for the question to be phrased with the same precision that the scientist demands for himself in the phrasing of problems.

An immediate example that has occurred just in the last couple of years is the public clamor for something to be done about diabetes, as the third leading cause of death and as the first leading cause of blindness in the United States. Societal clamor has triggered an enormous amount of research in this area, with the evolution, and I think the foreseeable product, of very translatable results, translatable in terms of how do eyes go bad, how do kidneys go bad, what can we do about nerves, what can we perhaps do about diminishing the incidence, and this sort of well-defined, quantifiable question.

In this regard, I think it is very important that such questions as are enunciated be defined with measurable parameters. We spoke a great deal yesterday, for example, about pregnancy. Perhaps it might be effective to trace my own identification with this field for you. I became interested in this as the classical sequence of the physician-biologist--that is, the physician who sees problems at the bedside, who identifies them, and tries to carry them as far as he can, independent of where his peregrinations will carry him, but in the hope that he will get some answers that he can transfer to the bedside. I was intrigued by this because 10 or 20 percent of all babies of diabetic mothers were dead sometime in the perinatal period, and gestational diabetes and diabetes of pregnancy occurred in one of every 200 to 300 pregnancies, a truly significant incidence.

We recognized that to do anything here, one had to define what pregnancy per se does to intermediary metabolism. As a consequence of these investigations, new approaches for tighter regulation have emanated, which have now reduced, in most laboratories where there are tight efforts underway, perinatal mortality to 5 percent. Yet, we have in no way diminished congenital anomalies, which are still three to six times as frequent and twice as fatal as in the nondiabetic, nor have we then necessarily modified a variety of other things.

What we tried to emphasize in the conference yesterday is that in viewing the whole problem of pregnancy we can no longer talk about perinatal mortality as a meaningful end point; we now have to go into more subtle parameters: the long-range impact upon psychosocial development, intellectual development, metabolic development, muscle development, etc. In all these arenas there are conceivably quantifiable parameters. We can measure the IQ of the newborn and the IQ in later life. We can measure muscle mass and adipocyte in the newborn and in later life. We can measure metabolic parameters and neuroendocrine integrations in later life.

In other words, we have transformed a social problem into a scientifically answerable or soluble arena. But the motivation was the problem of a biologist responding to disease that he saw at the bedside. And this, I think, in the final analysis, would always be the biomedical motivation. Meetings such as this and the wonderful points articulated by so many of the consumers really re-emphasize for many of us those things that we perceive at the bedside, and the need to approach them.

But I would say that in so doing, we must recognize that a diversity of disciplines must be enrolled. I very much appreciated Mr. Hitt's excellent comments. I was somewhat distressed, though, that after 2 days he would still emphasize that there must be a mandatory, single, unified, or unifocal class of citizen called a nutritionist. I thought that the last 2 days clearly delineated that one cannot study the traffic of fuels or metabolism of fuels without concomitantly analyzing what happens to the hormones that handle the traffic of fuels; i.e., insulin and glucagon. I thought the last 2 days had clearly delineated that one cannot talk about fuels without thinking of the neurobiological implications, a field of investigation which was largely initiated by Dr. Wurtman, acting as a neuroendocrinologist, not as a nutritionist.

I would beg that, if something evolved from our discussion today, it is the recognition that we do nutrition an enormous amount of disservice by narrowly circumscribing the definition of what it is. In response to Mr. Hitt's question, "Where is the vision and creativity that characterized the NIH in the past?", I would say that nutrition is alive and well, and has been traveling under a pseudonym called metabolism, endocrinology, bacteriology, immunology, etc.

In essence the situation can be aptly described by one of my favorite aphorisms from John Gardner: "We are surrounded by magnificent opportunities cleverly disguised as insoluble problems." That seems to very much summarize the status of nutrition today. Let us hope that the 1980s will enable us to approach some of these "insoluble problems" and recognize them for the magnificent "opportunities" that they truly represent.

DR. MUNRO:

I have a few major points that I would like to make. First, there is the question of where the nutrition community as such is going, and I gather from Dr. Freinkel that perhaps it is a very wide community without much focus. I think there is a need for focus. As president of the American Institute of Nutrition, I feel a certain amount of responsibility for asking the question: How many persons trained in nutrition will be needed in the future? For example, all the new centers that are developing at USDA and that are projected by NIH will require personnel. What should the personnel be? What should they be trained in? Furthermore, in what departments are they going to receive their training? I will note here the considerable instability of existing or past Departments of Nutrition. They have, on the whole, come and gone at universities, notably at private universities.

There is also the necessity for having training funds available for such personnel, and there must be a clear mandate for specific types of training that lead to specific types of skills.

The issue that has just been raised by Dr. Freinkel is the cooperation of so many different disciplines within nutrition. I think that in so doing he has drawn attention to the need to attract basic research scientists into the area of nutrition. The problem is not one of wanting to use basic science. The problem is one of transfer of information within the scientific community. This means that we require essentially better, more demanding leadership. I am particularly impressed by much of the confusion and lack of leadership within the nutrition community, and particularly within the clinical nutrition community.

That is point number one. We have to find out what the future has in terms of requirements for people to do the work.

The second question emerges from the first one, namely: How can we harness basic research to provide answers that are meaningful in terms of human welfare? Let me return briefly to the topic that I was in charge of yesterday--"Nutrition and Performance." The ultimate is, in fact, optimal performance in health, optimal resistance and recovery from disease, aging with dignity and without undue impairments.

In these areas we really need research workers who have a considerable insight into biological function. In fact, performance throughout life is a continuous process of change and adaptation. It is probably programmed in utero. It may even be programmed to some extent during adolescence. For example, a survey in the Boston area that ran over 40 years involved a cohort of individuals in which there was said to be a correlation between their nutritional status at adolescence and the capacity of the girls to give birth to full-sized infants without too many abnormalities some years later. Here, apparently, there is a relationship between performance in terms of nutritional intake during adolescence and the pregnancy outcome later on. This is further evidence of a situation that has been observed both in animals, as Dr. Galler mentioned, and in humans; namely that one generation's intrauterine nutrition can later affect the progeny of females from that generation, no doubt due to hormonal and metabolic responses to pregnancy.

We are interested in the programming of one organ, the placenta, which has a distinctly short lifespan. A change occurs in hormonal patterns of peptide hormones secreted into the maternal blood during the 9-month span of this particular organ. Recently we have been investigating the molecular biology of hormonal control in this organ and the effects of malnutrition, and especially of alcohol, on the capacity to produce the hormone that is secreted in the latter part of pregnancy, placental lactogen. Indeed, placental lactogen appears to be reduced in its secretory level because less protein synthesis of this particular hormone is progressing in alcohol-treated rats. This means that the signals going to the mother to send nutrients through the placenta are diminished, and as a result fetal size is reduced.

We thus have an example of programming and its sensitivity to nutrition. Can we assume that there are effects of nutrition in early life on the way that the genetic material will function throughout the remainder of extrauterine life?

Thus one is trying to coordinate the practical, everyday problem of producing babies who are in excellent health with the basic research problem of attempting to determine why, at the most basic level, the product can be suboptimal. It is this kind of approach which I believe could enrich the future of research into nutrition, and therefore I agree with Dr. Freinkel that indeed we need to enrich the nutrition field with ideas from all aspects of biological sciences. But I also worry, as in the first part of my commentary, whether we will have enough Departments of Nutrition to be thus enriched with these new ideas.

DR. HIRSCH:

In our discussions among ourselves in this group we have often talked about Clinical Nutrition Departments, who should head them, and what the departments should do. I must say that many of us think of these as being particularly conducive to the medical school setting. Although it is going to be difficult for us this afternoon to arrive at very specific recommendations, I think most of us agree that the personnel problem in this area is a key one--that the medical school is an important arena for the development of this kind of person, and that in recent years new approaches in patient care have been developed that are beginning to define the specific role of the clinical nutritionist.

In this regard, we have asked Dr. Stanley Dudrick of the University of Texas at Houston, Department of Surgery, to join us. He was originally scheduled to be on Panel V, "Nutrition and Performance," but unfortunately could not be here at that time. Dr. Dudrick will talk to us today about the functions of a clinical nutritionist, not so much in terms of research or research translation, but the day-to-day problems of patient care.

DR. DUDRICK:

Perhaps in establishing my credentials, I should begin by saying that, because I am here, 61 patients of mine in Houston are being cared for by somebody else. Of those, there are 44 patients whom no one in this audience would have any difficulty whatsoever in identifying as having a concurrent nutritional problem superimposed upon whatever the primary pathology or secondary complications might be. Thus, malnutrition is a very real thing to me. In a sense I represent, along with many other people in the audience and on this panel, the final common pathway of nutrition to many people, because surgical patients put themselves under our care almost exclusively. They abrogate all their privileges and human rights, in a sense, when they go in the hospital, especially on a surgical service where we really take over and regiment them. We tell them what to do and what not to do, and literally run their lives, including their nutrition and the air they breathe. We manipulate everything. We tell them how much oxygen they can breathe, how much fluids they can take, how many electrolytes they can take in, what nutrients they will take in. I cannot imagine any more power given to a human being except, as Dr. Munro has mentioned, to the mother of the fetus during the period of time that she exclusively controls the nutrition of her charge.

Thus nutrition has a great deal of relevance to me, and I am not really a nutritionist. I did not raise my hand when Mr. Hitt asked hands to be raised. I am primarily a physician, secondly a surgeon, and third a nutritionist. This progression developed out of necessity. I became a physician because I wanted to care for the ill. I became a surgeon because I was frustrated that I could not take care of everybody, and decided I had to learn how to operate if I really wanted to do everything. I became a nutritionist because I realized that--despite the fact that I had very potent tools pharmacologically, psychologically, and otherwise to care for a patient, and even though I could add surgical skills to help cure or allay certain disease processes--in many, many cases all was for naught unless the patient was in optimal nutritional status, or unless I could maintain him in optimal or near optimal nutritional status during the provision of all the skills that medicine and research before it has brought to bear or has put into the armamentarium that I use.

So I became a nutritionist through the back door, out of necessity, out of frustration. The need is there. Nowhere is it more evident, I think, than in the clinical situation with critically ill patients. There is a very nice paragraph in the description of Panel 2 in the program agenda: "Thus, pregnancy constitutes a unique opportunity for nutritional and biochemical engineering. It is the arena par excellence in which nurture, as exemplified by the character of maternal fuels, may influence nature, as represented by the intrinsic genetic endowment of the fetus. No single period in human development provides a greater potential for long-range 'pay-off' via a relatively short-range period of enlightened nutritional manipulation."

Now, I cannot be a mother, so I am never going to be able to take care of a fetus myself. But I think, in the game in which I play every day, I come about as close to that as you can. We are dealing with patients who are critically ill, who have hypermetabolism as a result of either accidental or for that matter surgical trauma.

If you superimpose sepsis, if you have malignant disease and multiple organ failure, I cannot think of anything closer to what a fetus must be going through in terms of the rapidity and the multiplicity of chemical reactions going on at all times. Our colleagues in biochemistry have taught us for years that if you want to learn something about a chemical reaction, you accelerate it. The faster you make it go, the more you might learn. And do not forget, we are constantly anabolizing, or building tissue, and catabolizing, or breaking it down. If we want to learn something about the human body, I think it is the surgical patients that we might learn something about, and these are the patients in whom I am interested.

I am really selfish in my goals with nutrition, because as a clinical surgeon I am basically goal-oriented or result-oriented, not in the sense that you might have heard here today, but because my patients and their families expect results, and I mean good results. They really expect everything to turn out optimally. And as I said earlier, you cannot possibly get optimal results when the patient is in a state of malnutrition. There is no disease process or disorder known to man in which the patient could be expected to do better when he is malnourished than when he is optimally nourished. I will literally do anything to help patients, and nutrition seems to be an answer.

It is important to remember that in nutrition we cannot get, and should not expect, instant results. We have come so far in the past decade it absolutely boggles my mind, and yet people expect even more. If we can get to the moon, why aren't we on Mars? Well, we will get there, just give us time. But in the process, do not divide and conquer us.

I am saddened when I hear people talk about prevention versus treatment. That is about as artificial a division as I can conceive. It can bring nothing but bad down the line. It makes artificial antagonists or adversaries of people who are delivering care and those who are trying to make the environment a better one in which to prevent a disease process. Be very wary of people who use that ploy on those of us in science and clinical practice. We cannot afford to be divided.

Preventative and therapeutic endeavors complement each other. We often learn things when we try to treat a disease which, when extrapolated backward from the clinical situation to clinical research to basic research, bring forth knowledge that can then be used to prevent the development of such a disorder in the future. On the other hand, basic research can often be used in the clinical research setting and applied to man therapeutically, having started once as a preventative measure. So we do have considerable interaction.

A championship football team is composed of 11 specialists working together. And that is what we are going to need, a football team. This is not a decathlon match, where one man has to do it all. It really is a football team, and that concept has to be preserved.

DR. LEVEILLE:

To begin with, I think it is imperative to recognize the crucial role that NIH has played in supporting fundamental research over these many years. It seems to me, as we look to the 1980s, that it is exceedingly important to continue that kind of support. We have the opportunity to understand the normally functioning organism as a point of departure from which to understand the abnormal situations and hence disease.

There are some specific areas of research that can be identified, and I will attempt to do that very quickly.

The relationship of nutrition to the prevention or delaying of chronic diseases is something that has been discussed, and certainly this is an area that requires urgent attention. I certainly would include obesity as one of these chronic diseases.

The whole area of nutrition and behavior also demands increasing attention. We do not know a great deal about how to approach research in this area, but certainly we must devote more resources to the expansion of our knowledge base, and thereby begin to understand how nutrition influences behavior and, conversely, how behavior can influence nutrition.

The area of nutrition surveillance has been brought up on several occasions, and I agree it is important. It seems strange to me that a country as affluent as the United States would not have evolved a system of nutrition surveillance. One of the reasons, very clearly, is the lack of effective tools. We don't really know how to measure nutritional status as effectively as we might like. I think this is a researchable area that demands attention. We must develop better means of assessing nutritional status of the population and do so on a regular basis so that we can anticipate problems on a short term, not every decade.

One of the topics of discussion that I always cringe at, and we touched on it several times, is that of the variability in human nutrient requirements. To be sure, there is some variability between individuals. We are a heterogeneous group. Nonetheless, the evidence available certainly does not suggest differences that are of orders of magnitude. The available evidence for those nutrients where we have sufficient data to evaluate individual variation would suggest a coefficient of variability of the order of 15 to 20 percent, perhaps as high as 30 percent, but certainly not much greater. Consequently, it is important, when we talk about individual variability, to recognize that we are talking about a rather narrow range. Thus much of the information reaching the general public about nutrient needs that are several times in excess of published requirements or allowances clearly is not based on available scientific evidence. This area needs to be studied in greater depth, and we need to develop better information on the variability between individuals.

I would like to join the others in stressing the need for training personnel. Clearly, we need many more individuals than we are currrently training. I would look to NIH as a source of support for this training; both pre- and post-doctoral fellowships and traineeships are needed. I would not go as far as Dr. Hirsch has gone in terms of indicating that clinical training should be only in a medical school. We are evolving a variety of models on our campuses that differ from the traditional medical school department, and I think that many of these departments can train individuals as effectively and perhaps more so in terms of developing a true team approach to the delivery of medical care, particularly insofar as nutrition is concerned.

I, along with many other speakers, support the notion that consumers have a role to play and should have a voice in the establishment of research priorities. However, I would sound a note of caution. I think it is important that an effective communication mechanism be developed so research areas are evolved which are meaningful, which are researchable, and which are likely to be productive. We cannot have the research community spending all its time evaluating hypotheses that have no real basis in fact, which is often what develops from people who are uninformed in the sciences. Dr. McNutt mentioned this morning a model that the Food and Nutrition Board is evolving. We are developing an effective means of communicating with consumers; we have had and are still having some growth pains, but I think an effective mechanism can be developed to focus on problems that are important to consumers and that are in fact researchable.

Finally, I would end with another note of caution with regard to recommendations to consumers. I certainly agree that we need guidelines to allow consumers to select a diet that is healthful. We need a means of helping consumers translate the science of nutrition into food terms that they can understand, use, and apply. But I think it is exceedingly important to remember that, while nutrition is extremely important, it is not a panacea, and we should not be promising more than the science can deliver at this time. We have a responsibility to interpret the present state-of-the-art in an applicable way for consumers, but we should not go beyond the available science. This is exceedingly important.

We have talked a great deal about evaluating the science, interpreting the science, and communicating it to organizations that are available and I think should be looked to, and not rely entirely upon NIH. For example, the Food and Nutrition Board of the National Academy of Sciences has been established particularly for that purpose and can draw on a very broad spectrum of the scientific community, and the National Nutrition Consortium is established for that same purpose.

DR. HIRSCH:

I apologize. Coming from Rockefeller University, I have always tried to say "medical schools and health-related facilities," but I must have slipped this time.

DR. HARPER:

I am sorry that Dr. Eliot Stellar had to leave, because he would have told you about the regulation of food intake, the relationship of that to obesity, and the importance of the behavioral sciences together with nutrition, in bringing us to a solution for that problem. There is no question but that we need further information about all aspects of food intake regulation, and there is no question in my mind but that this is one of the frontiers of the 1980s. We need to know more about the integration of information in the central nervous system in regulation of food intake, and we need more information about where those signals arise, some of them from the senses, some of them from metabolism in the body, and some of them from the environment.

I am worried if, as Dr. Freinkel says, nutritionists have gone underground in other departments. If this is so, we may not be able to find them when we want them. I support Dr. Munro's view that there should be identifiable nutrition departments; otherwise, where are the nutritionists going to come to enrich the medical science departments that are working on all these fascinating problems? One of the points that I made very strongly when the GAO asked for information about nutrition research priorities was that nutrition had suffered during the 1950s, when money was being handed out freely for research and development, because nutrition was not a well-organized science at the time. During that period, biochemistry, genetics, and microbiology departments had tremendous growth. There were development grants. There were faculty support grants. The personnel that were needed to attack many biochemical, genetic, and microbiological problems were educated during that period. There is a serious need for that type of development in nutrition if we want to have enough nutritionists to answer all the questions that everybody feels we need to answer.

Then I come to the question of the transmission of information. Here I want to mention, as did Dr. Leveille, cautions, even dangers, and to come back to something that Dr. Dudrick said. I think there is great danger of oversimplification. Dr. Dwyer talked this morning about the superior understanding of scientists and their failure to communicate, which implies an arrogance of scientists, or an arrogance of those who have special knowledge. There is also an arrogance of ignorance, and there is an arrogance of power. Serious problems are created by the ease with which broad general statements based on a few selected surface observations are accepted, while all the complexities that are evident if one looks below the surface are ignored. It is very easy for the public to accept oversimplifications because it requires no judgment and no critical evaluation.

One of the things that pleased me very much about the congressional panel this morning was that, on the whole, they expressed concern about the problems of misinformation and oversimplification. It is very important that we face this. I am not convinced that scientists fail to communicate. I am not sure how they are supposed to communicate. Presumably they are supposed to get information into newspapers and other communication media where the public will read or hear it. What amazes me is how much information the public gets about nutrition, although it may be oversimplified, sometimes garbled, and often misleading. Even in areas in my own special field I sometimes read a report in the newspaper before I find it in a scientific journal. The reason so many questions are being asked of scientists is because the public gets so much information about scientific developments in nutrition. They have read simplified versions of problems and want to know why scientists do not have comparably simple answers.

I am a little concerned about some of the conflicts that arose in the consumer panel this morning. I think we need to be very careful about this. Mr. Choate wanted the public to be educated so they would be discerning and critical in relation to the information that was provided to them, no matter from whom. On the other hand, Dr. Jacobson wanted to present the public with a simple set of dietary laws that would be enforced by Government agencies insofar as possible so the public would not have to be discerning and critical. There is a conflict here that needs to be resolved if we are going to present the public with information that will be useful for them.

This brings me to what Dr. Dudrick said. Division within the nutrition community, within the biomedical sciences generally, which leads to artificial separation between curative and preventive medicine, is not without danger. Having people on the one hand oversimplifying relationships between diet and disease to the point where they have very little meaning, and some on the other making them so complex that no one can understand them, tends to lead to the adversary approach and confrontation. Scientific problems cannot be resolved that way. The only way of resolving them is through detente, and to me detente means reconciliation through objective evaluation of the scientific evidence. Several of the panelists have brought this out today.

There are other problems I would like to mention. One of them has to do with defining terms. I have the impression that nutrition has been defined at least three times in the last decade. Once it was defined as an understanding of the nutrients that were required to maintain health. Then it was defined as welfare. Programs such as the Food Stamp Program were developed as a substitute for economic assistance programs, but they were called nutrition programs because the term "economic assistance" was not a politically acceptable term whereas "nutrition" was. We have come now to the point where we want to equate disease prevention with nutrition. Comprehensive medical care is what we are talking about, but no one wants to use that term because of what has happened with Proposition 13 in California.

Disease prevention, insofar as it can be accomplished, involves not just nutrition. It involves physical care of the body, attention to the environment and to the variety of interactions between the two. We need to be very careful about diluting the term "nutrition" in this way. What will happen is that we will develop programs that we call nutrition programs (Mr. Brandon mentioned the problem of monitoring and evaluating such programs), but which are in reality health or welfare programs. Then we shall monitor them and evaluate them on the basis of their nutrition contribution; if the nutritional effect cannot be measured, nutrition and health and welfare programs will all be in serious trouble.

Finally, a word about research priorities is in order and the role that the consumer should have in developing research priorities. It is important for the consumer to let scientists who are working on problems know what problems they feel are important. It is also important for consumers to recognize that certain problems are highly researchable; we have background knowledge of certain problems; we have the necessary techniques; we know the directions; and we can go ahead and solve them. Whereas, with others we need insight that we do not yet have; sometimes tools or techniques are needed that have not been invented. We can invest all the money in the world in problems of this type, but if we don't find the two or three individuals with the insight or with the appropriate tools, no progress will be made no matter how much money is invested. However, you can rest assured that we have people who will be able to spend the money. The problem that must be faced is that we can set priorities today or tomorrow, but it takes only one individual with great insight to make it necessary to change priorities within a few days.

I don't want us to get to the point where we define priorities rigidly and thus lose the flexibility of being able to change them as information that necessitates changes comes along.

DR. OMENN:

So much has been said, and much of it has been very interesting and enlightening. I support most everything that has come from many different sources.

It is worth emphasizing toward the close of our session that food is pervasive in our lives and our pleasures. It is quite clear that nutrition has become a major political and scientific subject.

When I went to medical school, we did have nutrition lectures. Sadly enough, that was the reason that most medical graduates from my school are not interested in nutrition. In fact, what interest did develop came, in part, from the field that Dr. Dudrick described. Dr. Francis Moore and other surgeons who cared for patients had to deal with nutrition, and they presented human nutrition issues in a practical and effective way. The biochemist and geneticist talked about it in terms of metabolic pathways where it made sense.

In terms of modern medicine, nutrition became exciting. I think this is the difficult challenge before us. This is the late 1970s; we are talking about the 80s and beyond, and we need to be looking forward. We need to be taking advantage of the modern advances in all kinds of fields of biological sciences and also in food and engineering sciences, which we have discussed very little at this conference.

I would urge those of you who are interested to review the document prepared by the Interagency Administration Working Group [New Directions in Federally-Supported Human Nutrition Research, Office of Science and Technology Policy, Executive Office of the President, December 1977]. In that report, there are four large areas of high priority research: 1) effects of nutrition on human health and performance; 2) food sciences research; 3) nutrition education research; and 4) diet and nutritional status surveillance and its methodology.

We think there are major opportunities at hand in all those areas, and we identified them. We went out on limbs. We didn't just take diseases that have a major burden and are popular. We picked diseases for which we feel there are available methodologies now, important large population needs, and the opportunity to identify and direct scientific investigation. We emphasized these diseases in terms of scientific opportunity, yet the role of nutrition was also recognized in heart disease, cancer, and other fields already fairly well funded.

Nutrition should be taught to students and to the public by nutritionists, but I am a little fearful that, if the research is left to nutritionists, we will miss many opportunities. We face the same issue in the Office of Science and Technology Policy with regard to toxicology. In fact, toxicology and nutrition overlap in many respects.

I think the notion that we should eschew double-counting is a dangerous criticism. In fact, most managers today deal in matrix analysis. We know that there are a tremendous number of overlaps, and in everything to do with research and education we otherwise glorify interdisciplinary and multidisciplinary approaches. I think that to suggest that studies of coronary artery disease and nutritional relationships should be done only by people who are dietitians or nutritionists, and not by excellent lipid biochemists or membrane physicists or clinicians or others, would miss the boat.

Next, let me refer to the famous statement made by Lyndon Johnson that the secrets are locked up in our laboratories and need to be gotten out into use. I think many people now regard that as an inappropriate conclusion--that in fact, in most areas of biomedical technology, applications have been premature. It is certainly true in nutrition that every claim that gets into the National Enquirer reaches 35 million people within days. It doesn't wait for the journals. The big problem is determining from the deluge of information what is reliable, what is substantiable, what is important, what can be confirmed.

Finally, I think it is appropriate behavior for scientists to be highly critical, dissatisfied, discontent. It is expected to be a creative discontent. I would like to second the comments of those who have insisted that things may indeed be much better than they sound.

DR. HIRSCH:

Mr. Hitt, at the end of the Congressional Panel you threw down a gauntlet for us. Hopefully we have taken up your challenge. Would you like to comment?

MR. HITT:

I think the summary has been very good. It comes back to what people on the Hill deal with more than most people (or at least they think they deal with more than most people) and that is communication between all parties. A considerable amount of information funnels through us in the legislative process. The points that have been made here give me an opportunity to come to some conclusions of my own, at least, and to clarify some misunderstandings that resulted from some of the things I said earlier.

For example, I agree with Dr. Isselbacher in his observations regarding research on galactosemia, and I concur that the basis of all research is what has been done before. What I was concerned about that did not come out yesterday is how we tie the past to the projections for the future. I felt that there was not really a clear indication where the people who have spoken at this conference are heading or where they think the frontiers might be for the '80s.

Another point that is critically important to clarify, and that has been raised by several people on this panel, is that I am not saying that only nutritionists should do nutrition research. In fact, I think what is most important is the critical need for multidisciplinary approaches to nutrition problems. At the same time, I am trying to convey the following: How do we address these problems, and how much do we look at nutrition first and other areas second?

Another point should be corrected. We are putting a great deal of emphasis on pregnancy and childhood development. It would be ironic if, in fact, we directed all our energy toward this area and were not able to "solve the heart disease problem," so that in fact the children we save die prematurely as adults. It has been suggested that I implied the life span was getting shorter. That is not the case, since life expectancy is increasing, and I want to make that clear.

A third point is what Dr. Dudrick said about prevention versus treatment. That is certainly a wrong impression. What we are talking about is the balance between prevention and treatment and how these different approaches affect our thinking about a problem. It is important in the Congress, in particular, because in looking at health care costs, we wonder if we have possibly missed the boat in prevention.

The fourth point is that I have talked many times about the difficulty of the so-called "long road of research"--that you don't solve problems easily or quickly. In fact, I think we are just beginning to get over the successes of the '40s and '50s and the success of the moon shot, which may have given us a false sense of our research capabilities. We are into very complex problems at this point, and I think the false expectations, in the cancer program for example, are becoming very clear. Thus, again, the criticisms that may have been raised are not that the money per se has been wasted. I think Dr. Fredrickson is right, that we have done valuable cell biology research with the money, but when you get to the questions of potential and priorities and the point that Dr. Harper made about not getting too inflexible, maybe in cancer research the concern is that we have become too inflexible and that we keep going down the same roads.

Again, with respect to cancer research, no one on the Hill is advocating throwing money at a problem. We have learned that such approaches do not work. What we are talking about is a reasonable amount of money in the nutrition research area.

Another point that needs clarification is that I don't mean to imply that USDA is the "golden boy" between the two departments. The fact that three reports [GAO, OTA, and OSTP] were written indicates that USDA has not been doing the job it should be doing. What I was trying to convey is that Dr. Cutler indicated this morning what he called a fresh breath within the Department. We are hoping to see exactly the same thing with respect to NIH. This conference is an indication that things are going to move that way. At the same time, and not because I am on the Agriculture Committee now, we have not clearly been given the impression that NIH is moving as fast as USDA.

Finally, there is absolutely no question that we believe we have to support basic or fundamental research. But let us call basic research just that, with the understanding that basic research can be done by any number of people, for any number of reasons, for any number of outcomes. In addition, there is another category that has a much looser definition, which we need to work on, that might be called applied research. I think the Congress is satisfied with the two categories, and is even more satisfied to know that a certain basic research project could have future application in several areas.

DR. HIRSCH:

As we near the conclusion of this conference, I would like to make a few brief observations.

It is clear that NIH, by virtue of having this conference, is making a strong commitment to clinical nutrition and associated problems. So, I think the very fact that this panel is sitting here and this conference has been held shows that NIH wishes to maintain a strong commitment to clinical nutrition.

In addition, it is obvious that NIH does not wish to work in a vacuum--but in close concert with Congress, other Federal agencies, and with the public. This is evidenced by the fact that special consumer and congressional panels were invited to participate, that representatives from other agencies were asked to present their programs in nutrition, and that the individuals who were responsible for setting up this meeting were not just the NIH Nutrition Coordinating Committee but were persons called in from the scientific community.

All these facts augur well for the NIH and for clinical nutrition.

I should like to extend my special thanks to Dr. Fredrickson, the members of the Nutrition Coordinating Committee, and particularly Dr. Perry and Dr. Simopoulos for helping this conference to be a success.

DR. PERRY:

During this conference, we have heard an assessment of the state-of-the-art of nutrition research. That assessment focused on most of the important areas in nutrition research.

We have also heard a good deal of criticism, and we have received a good deal of advice. As the critics themselves may recognize, there are some messages and problems for them within that advice.

We will take the criticisms we have heard quite seriously, because the purpose of this meeting has been to get an assessment from a variety of perspectives on the NIH program in nutrition research. Nevertheless, it is fair to say that the NIH has recognized some of its deficiencies. It could be said that we are moving slowly in remedying these deficiencies, but on the other hand, we are moving.

First, the very fact that this meeting was held is significant. It demonstrates the NIH commitment to nutrition. Undoubtedly, it has been one of the most important meetings of its kind.

Second, we plan to expand and intensify our nutrition education activities. The Nutrition Coordinating Committee has made definitive progress in this important area.

And finally, the concept of Clinical Nutrition Research Units has received considerable attention at this conference. As Dr. Simopoulos explained in her presentation, the NIH, through its Nutrition Coordinating Committee, has been exploring the establishment of Clinical Nutrition Research Units, both within the Clinical Center and in institutions across the country, for some time.

Thus, the NIH will continue to sponsor and conduct biomedical research designed to improve the quality of life for all Americans through optimal nutrition.

APPENDIX I: CONFERENCE PROGRAM AGENDA

Monday, June 19, 1978

8:00 Registration

9:00 Greetings and Introduction

Donald S. Fredrickson
Director, National Institutes of Health

9:15 Conference Address

Hale Champion
Under Secretary, Department of Health, Education, and Welfare

9:30 Conference Address

Julius Richmond
Assistant Secretary for Health, Department of Health, Education, and Welfare

9:40 Scientific Panels

Chairman: Seymour Perry
Associate Director for Medical Applications of Research, and Chairman, Nutrition Coordinating Committee, NIH

9:45 Panel I: "Genetic Disorders: Lessons for Clinical Nutrition:

Panel leader: Kurt Isselbacher
Massachusetts General Hospital

Panelists: Joseph L. Goldstein
University of Texas Health Center at Dallas

Charles R. Scriver
Montreal Children's Hopsital

Discussion

11:00 Coffee Break

11:15 Panel II: "Nutrition in Pregnancy and Early Life: Long-Range Dividends for Brief, Enlightened Efforts"

Panel leader: Norbert Freinkel
Northwestern University

Panelists: John F. Wilber
Northwestern University

Jules Hirsch
Rockefeller University

Discussion

12:15 Lunch

1:00 "The Intellectual Basis of Research in Clinical Nutrition"

Rene Dubos
Rockefeller University

2:00 Panel III: "Basic Biochemical Research: A Key to the Solution of Nutritional Disorders"

Panel leader: Gilbert Leveille
Michigan State University

Panelists: Hector F. DeLuca
University of Wisconsin

Dale R. Romsos
Michigan State University

Harry P. Broquist
Vanderbilt University

Edward D. Harris
Texas A&M University

Discussion

3:00 Panel IV: "Nutritional and Environmental Practices: Consequences for Health"

Panel leader: E. H. Ahrens, Jr.
Rockefeller University

Panelists: Attallah Kappas
Rockefeller University

Gerald Gaull
New York State Institute for Basic Research in Mental Retardation

Discussion

4:00 Panel V: "Nutrition and Performance"

Panel leader: Hamish Munro
Massachusetts Institute of Technology

Panelists: John E. Canham
Letterman Army Institute of Research

John Daly
University of Texas Medical School

Janina Galler
Boston University Medical Center

Discussion

5:00 Panel VI: "Nutrition and Behavior: Interactions:

Panel leaders: Alfred Harper
University of Wisconsin

Eliot Stellar
University of Pennsylvania

Panelists: Paul Rozin
University of Pennsylvania

Alan N. Epstein
University of Pennsylvania

Richard J. Wurtman
Massachusetts Institute of Technology

Discussion

Tuesday, June 20, 1978

8:00 Registration

9:00 Opening Remarks

Donald S. Fredrickson
Director, National Institutes of Health

9:10 Conference Address

Honorable Henry L. Bellmon
United States Senate

9:40 Federal, Congressional, and Consumer Aspects of Nutrition Research and Education

Chairman: J. Michael McGinnis
Deputy Assistant Secretary for Health, Department of Health, Education, and Welfare

9:45 The NIH Program in Clinical Nutrition Research

Speaker: Artemis P. Simopoulos
Special Assistant for Coordination of Nutrition Programs, Office of the Director

10:30 The FDA Program in Nutrition

Speaker: Sanford Miller
Director, Bureau of Foods, Food and Drug Administration

11:15 The DOD Program in Nutrition

Speaker: John E. Canham
Commander, Letterman Army Institute of Research

11:30 The USDA Program in Nutrition

Speaker: M. Rupert Cutler
Assistant Secretary for Conservation, Research, and Education, U.S. Department of Agriculture

11:45 Consumer Panel

Panel leader: Gilbert Omenn
Office of Science and Technology Policy

Panelists: Michael Jacobson
Center for Science in the Public Interest

Jonathan Meyerson
U.S. Department of Agriculture

Allan Forbes
Food and Drug Administration

Robert Choate
Council on Children, Media, and Merchandising

Kristen McNutt
Senate Committee on Agriculture, Nutrition, and Forestry

Johanna Dwyer
Francis Stern Nutrition Center, Tufts

Discussion

12:45 Lunch

1:30 Congressional Panel

Panel leader: Chris Hitt
Subcommittee on Nutrition, Senate Committee on Agriculture, Nutrition, and Forestry

Panelists: David Blumenthal
Senate Health and Scientific Research Subcommittee

Rick Brandon
Senate Budget Committee

Joe Crapa
House Domestic Marketing, Consumer Relations and Nutrition Subcommittee

Richard G. Woods
Senate Labor-HEW Appropriations Subcommittee

Discussion

2:30 A Projection for the 1980s

Chairman: Jules Hirsch
Rockefeller University

Panel discussion:

Kurt Isselbacher
Norbert Freinkel
Gilbert Leveille
E. H. Ahrens, Jr.
Hamish Munro
Stanley Dudrick
Alfred Harper
Eliot Stellar
Gilbert Omenn
Chris Hitt

4:00 Conference Conclusion

APPENDIX II: REQUEST FOR APPLICATIONS:[1,2] "CORE GRANTS FOR CLINICAL NUTRITION RESEARCH UNITS (CNRUs)"

INVITATION

The National Institutes of Health (NIH) invites applications for core grants in support of Clinical Nutrition Research Units (CNRUs). A CNRU is an integrated array of research, educational, and service activities that is oriented toward human nutrition in health and disease. Core grants facilitate the planning and coordination of the activities of the Units primarily by providing funding for facilities and associated staff that serve the various projects of the Unit on a shared basis. This solicitation is a joint effort of the following Institutes of the NIH:

National Institute of Arthritis,
Metabolism and Digestive Diseases

National Cancer Institute

National Institute on Aging

BACKGROUND

Advances in our knowledge of human biochemistry and physiology have begun to place clinical nutrition on a sound, scientific base. A large number of deficiency states, consequences of inborn errors of metabolism, and food-related diseases are now understood, treatable, and often preventable. However, there remain many unanswered questions on the relationship of diet to health and disease, especially cancer and other chronic diseases, and aging. Current and future investigations of these relationships will advance our understanding of human nutrition.

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[1] This announcement is made under the authority of the Public Health Service Act, Section 301, as amended. Awards will be administered subject to Code of Federal Regulations, Title 42, Part 52; Title 45, Part 74; PHS Grants Policy Statement; and other terms and conditions of the award document.

[2] Originally printed as a Supplement to the NIH Guide for Grants and Contracts on January 26, 1979.

Advances in nutritional sciences are derived from and thus dependent upon many disciplines (such as biochemistry, molecular biology, genetics, physiology) and medical specialties (such as internal medicine, pediatrics, and surgery). Thus nutritional science is interdisciplinary and complex and is heavily dependent upon the close interaction among research, health services, and education to achieve its full potential.

There is growing public desire for more information on the role of dietary practices in disease prevention. The National Institutes of Health, which has from its inception performed and supported research on the relationship of diet to health and disease, will continue to have a major commitment for uncovering new nutritional information and for imparting this information to physicians, other health professionals, and the public.

The NIH has traditionally sponsored the component activities of CNRUs through a variety of award mechanisms: the principal ones have been research project grants and support for research training. The present initiative, core grants for shared facilities, is likely to become an invaluable addition, especially in promoting multidisciplinary interactions. This approach also tends to ensure that a given CNRU has multiple sponsors, both Federal and non-Federal, and thereby reduces the likelihood that it will become unduly dependent upon any one source of funds for its continuing operations. Funding for educational programs and nutritional support services (patient care) will generally be sought from sources other than the NIH.

The NIH will continue to provide support for certain activities to be carried out by CNRUs through the customary research project grant, and management of CNRU grants and other assistance mechanisms will be governed by the laws, regulations, and policies and other requirements which prevail for research grants.

OBJECTIVES OF THIS SOLICITATION FOR CORE GRANT APPLICATIONS

As a means of encouraging the desired multidisciplinary approach to clinical nutrition opportunities and problems, the NIH seeks to foster the development and operation of CNRUs. This solicitation for core grant applications is designed to complement NIH-supported project grants and training awards and relevant activities funded from other sources. The specific objectives are:

1. To create or strengthen foci in biomedical research institutions for multidisciplinary research in clinical nutrition in order to develop new knowledge about specific nutrients in health, human development, and the prevention and treatment of disease.

2. To strengthen training environments in order to improve the education of medical students, house staff, practicing physicians, and paramedical personnel in clinical nutrition.
3. To enhance patient care and promote good health by focusing attention on clinical nutrition and generating nutritional information for the public.

ESSENTIAL COMPONENTS OF A CNRU

A CNRU, at a minimum, must comprise the following seven components:

1. Research with human subjects and populations;
2. Laboratory investigations;
3. Research training;
4. Shared facilities and research services;
5. Education programs for medical students, house staff, practicing physicians, and paramedical personnel;
6. Nutritional support services; and
7. Public information activities.

A CNRU is most readily developed in a medical school, a school of public health, or a research hospital, but is not limited to these settings. Eligibility is limited to domestic institutions.

CHARACTERISTICS OF A CNRU

Professional Personnel

1. The leader of the CNRU should be a scientist recognized for his or her expertise in research on some aspect of clinical nutrition.
2. There should be at least two other associated senior investigators pursuing nutritional research.
3. There should be other professional personnel as required; e.g., research pharmacists, dietitians, nurses trained in intravenous techniques, technicians with expertise in stable isotope and metabolic balance studies, etc.

Laboratory Facilities

Each CNRU should have clinical research laboratories for special nutrition-related studies (e.g., metabolic, immunologic, endocrine, neuro-endocrine, and behavioral research). The availability of an NIH-supported General Clinical Research Center with a metabolic kitchen may prove a useful adjunct.

Research Training

Each Unit should accommodate postdoctoral and young investigator training in clinical nutrition, funded under usual research training mechanisms (i.e., NRSA institutional and individual awards) or from other sources. A commitment to provide opportunities for nutrition research training is required. Although stipends will not be provided in this award, applicants must indicate the manner in which the CNRU facilities and resources will facilitate research training.

Educational Programs (Supported by sources other than NIH)

It is expected that a CNRU will encourage the integration of nutrition education into other educational activities in relation to health promotion and disease prevention. Furthermore, the Unit should be actively involved in curriculum development, education of house staff, continuing education of physicians and other health professionals both within and outside its confines, and provide information to the general public.

Nutritional Support Services (Supported by sources other than NIH)

Nutritional support services should include an active clinical nutrition service for the assessment, maintenance, and improvement of the nutritional status of patients in the hospital and at home. A special unit for parenteral and enteral nutrition support is not an essential component of the nutritional support service but may be desirable in some settings.

Public Information Activities

It is expected that each CNRU will develop the appropriate mechanism for the application of research knowledge into public education derived from the CNRU activities.

ALLOWABLE BUDGETARY ITEMS FOR CNRUs

All applications for CNRUs should request and justify five years of support. Costs shown allowable in the current PHS Grants Policy Statement may be requested if properly justified.

1. Professional Personnel

   a. Core Facility Director: Partial salary support may be provided for the Director of the core facility in proportion to the amount of time or effort required for its administration and the associated planning and coordination of the activities of the CNRU. The Director of the core facility may be either the CNRU Principal Investigator or another individual designated by the institution and the P.I. In either case, the leader of the CNRU should be designated as the Principal Investigator of the CNRU grant.

   b. New Investigators: Temporary salary support may be provided to new investigators (only one individual at a time for a period of usually 24 months and not to exceed 36 months) in specified areas of research complementary to ongoing activities of the group. "New" refers to recently trained investigators or investigators new to nutrition research. Salary support may not be provided to investigators already established in nutrition research simply because they are new to the CNRU.

2. Shared Research Resources and Services

   The core grant may provide funds for the development and/or operation of laboratory and clinical nutrition research facilities and services that will be shared by several members of the staff; these may include expenditures for scientific and technical support personnel, nutrition assessment laboratory facilities, and supplies.

   Only research facilities which are not readily justified for support by an individual project award - or which by nature of being shared result in increased research capability - are allowed. Funds requested for clinical research activities must be clearly distinguished from costs incurred in the provision of normal clinical services.

   The extent of core grant support provided for shared research facilities and services is dependent upon their relationship to research activities.

3. Travel

It is expected that all CNRU Directors will meet annually for a two-day meeting at the NIH with NIH staff. Funds should be requested for this travel. The purpose of the annual meetings is to facilitate communication, to review research findings and problems, and to discuss administrative concerns and constraints. Thus, an active national program in clinical nutrition will be established.

Other travel expenditures directly associated with core activities may be allowed as justified.

4. Pilot Studies

Limited funds may be provided for short-term projects to explore the feasibility of new areas of study and new research leads. The combined direct costs for all such projects are limited to 10 per cent of the annual direct cost budget. Any pilot study to be supported for longer than one year from core funds must receive prior NIH approval for the longer award. The Unit director has responsibility for commitment of these funds and for insuring the quality of the research. Each proposed project to be supported must be described in the continuation application, and descriptions and budget allocations for new project starts must be given.

5. Publication Costs

Publication costs resulting from specific collaborative research activities facilitated by the core grant may be requested.

6. Reporting Requirements

An annual progress report and an annual report of expenditures are required.

OTHER SUPPORT

Where support for relevant projects or programs is provided or is being requested under other mechanisms, the other sources of support should be listed in the application by source and project number. This tabulation should be accompanied by a brief description of the project or program, as well as a statement of the commitment of its principal investigator to the general activities of the CNRU.

COST SHARING

The cost sharing requirements generally applicable to HEW-supported research grants and contracts are applicable to CNRU awards.

FUNDING

Although it is envisioned that most core grants to CNRUs will be supported by a single NIH Institute, more than one Institute may provide funding for a particular core grant. The NIH plans to make approximately 10 such core grants in the FY 1979 and 1980 time period. Although this program is included and provided for in the financial plans for FY 1980, award of grants in that fiscal year is contingent upon ultimate allocation of appropriated funds for this purpose.

METHOD AND CRITERIA FOR REVIEW

1. Receipt and Assignment of Applications

   Applications will be received by the Division of Research Grants, NIH, assigned to one or more Institutes, and referred to an appropriate peer review group for evaluation of scientific and technical merit. These decisions will be based on the principal scientific thrust of the CNRU and governed by normal program considerations specified in the DRG guidelines for the referral of grant applications.

2. Review and Funding Selection Procedures

   Applications in response to this announcement will be reviewed on a nationwide basis in competition with each other, and in accord with the usual NIH peer review procedures. They will first be reviewed for scientific and technical merit by an initial review group composed mostly of non-Federal scientific consultants. Following initial review, each application will be evaluated by the appropriate Institute Advisory Council or Board. An application must be recommended for approval by a Council or Board to be eligible for funding. The responsibility for determining whether or not a favorably recommended application is selected for an award rests with the staff of the Institute(s) to which the application is assigned.

EVALUATION CRITERIA

An NIH-supported core grant differs both in purpose and substance from regular research project grants and General Clinical Research Center grants. The reviewers will give particular attention to the following:

1. Clarity and appropriateness of the stated objectives of the CNRU;

2. The overall quality of the ongoing and planned scientific program that the core grant is to serve and the impact (realized and potential) of the CNRU on advances in clinical nutrition research;

3. Institutional commitments to research in the nutritional sciences and to the Unit, as well as the provision of space and institutional support;

4. The designation of a leader whose investigations and interests are already linked to clinical nutrition, including especially his or her background, training and experience, leadership capabilities, specific plans for research and administrative involvement, and authority in relation to recruitment, Unit staff appointments, space allocation, fiscal responsibility, and administrative responsibility;

5. Appropriateness and justification for requested budget items;

6. The potential contribution of any proposed new investigators to the overall research activities, their relationship to ongoing research activities, new capabilities and expertise they bring to the Unit, and future plans for research support beyond the intiial period;

7. The quality of the activities to be initiated with pilot funds and the proposed procedures for their allocation.

In addition, an overall evaluation of the following items will also be made: the opportunities for increased research activities across disciplinary or departmental lines; the degree to which ongoing activities will be strengthened and supplemented; staff awareness of the activities, needs, and potential interests of individual investigators associated with the CNRU; institutional commitment; and reasonableness of the budget.

All ongoing research projects related to nutrition, regardless of source of support, should be clearly identified and briefly described in the application. Participating research projects which have been funded individually by the NIH will not be reviewed again for scientific merit except as necessary for the evaluation of the core grant application. All pilot projects will be evaluated individually. Research not funded by NIH and described as part of the ongoing activities of the applicant institution may be reviewed for scientific merit and programmatic interest.

METHOD OF APPLYING

Applications should be submitted on form PHS 398, which is available in the business or grants and contracts office at most academic and research institutions, or which may be obtained directly from the NIH Division of Research Grants. The phrase "PREPARED IN RESPONSE TO NIH CLINICAL NUTRITION RESEARCH UNIT (CNRU) CORE AWARDS RFA" should be typed across the top of the first page of the application.

The first CNRU awards are to be made during FY 1979. Applications for the first competition are due NOT LATER THAN April 15, 1979. Applications received after April 15 will be retained for the subsequent review cycle.

The receipt date for a subsequent competition, to be funded in FY 1980, is October 1, 1979.

NOTE: This announcement is directly related to a previous announcement by the National Institute of Arthritis, Metabolism, and Digestive Diseases in the *NIH Guide for Grants and Contracts*, Vol. 7, No. 16, p. 23, November 1, 1978.

It supersedes and in effect revises those previously announced receipt dates as follows:

Prior Announcement	Revised Requirement
Feburary 1, 1979	April 15, 1979
June 1, 1979	None
October 1, 1979	Same

The original and six copies of the application should be sent or delivered to:

Application Receipt Office
Division of Research Grants
National Institutes of Health
Room 240, Westwood Building
Bethesda, Maryland 20205

For further information, applicants are encouraged to contact:

Gerald F. Combs, Ph.D.
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Metabolism, and Digestive Diseases
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APPENDIX III: LIST OF ABBREVIATIONS

AID	Agency for International Development
ATP	adenosine triphosphate
ATPase	adenosine triphosphatase
BCG	bacillus Calmette-Guerin
Ca	calcium
CDC	Center for Disease Control
CNRU	Clinical Nutrition Research Unit
DHEW	Department of Health, Education, and Welfare
DNA	deoxyribonucleic acid
DOD	Department of Defense
DRG	Division of Research Grants
DRR	Division of Research Resources
DRS	Division of Research Services
EFNEP	Expanded Food and Nutrition Education Program
FAO	Food and Agriculture Organization
FASEB	Federation of American Societies for Experimental Biology
FDA	Food and Drug Administration
FH	familial hypercholesterolemia
FTC	Federal Trade Commission
FY	fiscal year
GAO	General Accounting Office
GNP	gross national product
HANES	Health and Nutrition Examination Survey
HDL	high density lipoprotein
HEW	Health, Education, and Welfare (Department of)
INCAP	Institute of Nutrition for Central American and Panama
K	potassium
kcal	kilocalorie
LAIR	Letterman Army Institute of Research
LDL	low density lipoprotein

mg	milligram
MIT	Massachusetts Institute of Technology
ml	milliliter
N	normal
Na	sodium
NaCl	sodium chloride (salt)
NCC	Nutrition Coordinating Committee
NCHS	National Center for Health Statistics
NCI	National Cancer Institute
NEI	National Eye Institute
NFCS	National Food Consumption Survey
NHLBI	National Heart, Lung, and Blood Institute
NIA	National Institute on Aging
NIAID	National Institute of Allergy and Infectious Diseases
NIAMDD	National Institute of Arthritis, Metabolism, and Digestive Diseases
NICHD	National Institute of Child Health and Human Development
NIDR	National Institute of Dental Research
NIEHS	National Institute of Environmental Health Sciences
NIGMS	National Institute of General Medical Sciences
NIH	National Institutes of Health
NINCDS	National Institute of Neurological and Communicative Disorders and Stroke
NRSA	National Research Service Award
ob	obese gene
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
OTA	Office of Technology Assessment
PHS	Public Health Service
P.I.	principal investigator
PKU	phenylketonuria
PSA	public service announcement
RCDA	Research Career Development Award
RDA	Recommended Dietary Allowance
RFA	Request for Applications
RFP	Request for Proposals
SEA	Science and Education Administration
TRH	thyrotropin releasing hormone
TSH	thyroid stimulating hormone
USDA	U.S. Department of Agriculture

WHO	World Health Organization
WIC	USDA special supplemental food program for women, infants, and children

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NIH Publication No. 80-1970
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